Marriage, mining and mobility: four Durham parishes

Fowler, Lucinda J.

MARRIAGE, MINING AND MOBILITY: FOUR DURHAM PARISHES

M.Sc. THESIS

Lucinda J. Fowler

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Department of Anthropology,
Durham University

ABSTRACT

Population Genetics theory suggests that gene flow plays a prominent role in reducing genetic heterogeneity in a species. This project attempted to assess the opportunity for gene flow in an eastern Durham population in the nineteenth century by measuring the migration that is associated with marriage, then utilised these observations to predict changes in the genetical structure of the population. The marrriage data, obtained from Anglican Parish registers (1797-1876) and the 1851 Census, were analysed in the form of migration matrices which predicted the time taken for two places to become related and therefore genetically uniform. Coal-mining transformed the four parishes of the study area from an agricultural, sparsely populated region to a populous industrial complex. Historical observations suggested that this 'new' population was both spatially and socially distinct from the rural one and this was confirmed by the matrix analysis that indicated strong positive assortment for occupation which, it was thought, would lead to a 'patchy' distribution of genetical traits. The relative merits of the two data sources, the defects in the matrix technique and the implications for other industrial areas were discussed.

ACKNOWLEDGEMENTS

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CONTENTS

CHAPTER ONE: INTRODUCTION

Genetic variation in human populations over both large and small areas of Britain has been described in a number of studies of the frequencies of blood-groups and other genetic markers (e.g. Kopec 1970, Roberts 1953, Roberts & Sunderland 1973). The theory of population genetics suggests that three processes acting on mutation account for this variation: natural selection, genetic drift and gene flow. The relative importance of these processes in a particular community or group of communities can best be assessed by analysing the development of population structure through time. This can be attempted by the use of historical records.

The aim of this project is to assess the opportunity for gene flow in a population in County Durham. Gene flow can occur spatially, between populations in different geographical locations and socially, between stratified groups of individuals living in a particular place.

Gene flow between communities is most easily measured indirectly, by quantifying migration, which is the movement of individuals not genes. Of course, migration need not always be accompanied by gene flow as well demonstrated by the Old Order Amish who emigrated from Berne, Switzerland and now live in isolation as a closed, theocratic, rural society in Mid-West

America. Hence the measurement of mobility must be coupled with an analysis of the marriage structure in the population. This can be done by considering 'marriage distance', the geographical or social distance between marriage partners. In this way it should be possible to delimit the Mendelian populations (interbreeding groups) in an area.

In this project the aggregative techniques of historical demography were employed to ascertain the extent of immigration in a part of the eastern Durham coalfield during the nineteenth century, and to assess its contribution to the breeding structure of the population and thus its genetical implications. In particular, the concept of 'relatedness' was utilised to measure the effects of such movement on the homogeneity of the population. The material was obtained from Anglican Marriage records for the eighty year period 1797-1876 and the 1851 census enumerators returns for the four Durham Parishes of Dalton-le-Dale, Seaham, Easington and Castle Eden. Both these records give information on origin of marriage partners, but the meaning of origin is different in each case. Both were used to measure the 'marriage distance' between partners. Further, the parish records of 1837 onwards provide information on occupation of partners and their fathers which was used to determine the extent of social stratification.

The four eccelesiastical parishes constituting the study area are aligned on the east coast of Durham county, with Seaham to the north and Castle Eden to the south (see Maps 1.1 & 1.2). During the nineteenth century the area exhibited an interesting geographical and economic diversity: large mining communities interspersed with small rural villages and hamlets, while the port of Seaham Harbour represented the only major town. The majority of the inhabitants were engaged in the occupations of coal-mining, sea-faring and farming, but there were opportunities in building, the railway industry and the retail trade.

The area lies on the east Durham coalfield which was not opened up until the early 1820's because of the engineering problems posed by the presence of a thick, hard deposit of magnesian limestone. The first sinking through the limestone, which occurred in 1820 at Hetton-le-Hole, paved the way for a massive expansion of the coalfield in the next fifty years or so. The period between 1797 and 1876 was one of great population movement and, fortunately, it coincided with the availability of fairly precise data in the Census and registers. One of the aims of this project is to compare patterns of marital movement before and during the development of the mining industry.

The genetical composition of a population is the result of a complex interaction of a variety of factors. No such analysis can be complete without an investigation into the geography and

history of the area. Chapter Two attempts to summarise the information on migration present in historical sources and to consider the genetical implications of evidence for or against geographical isolation.

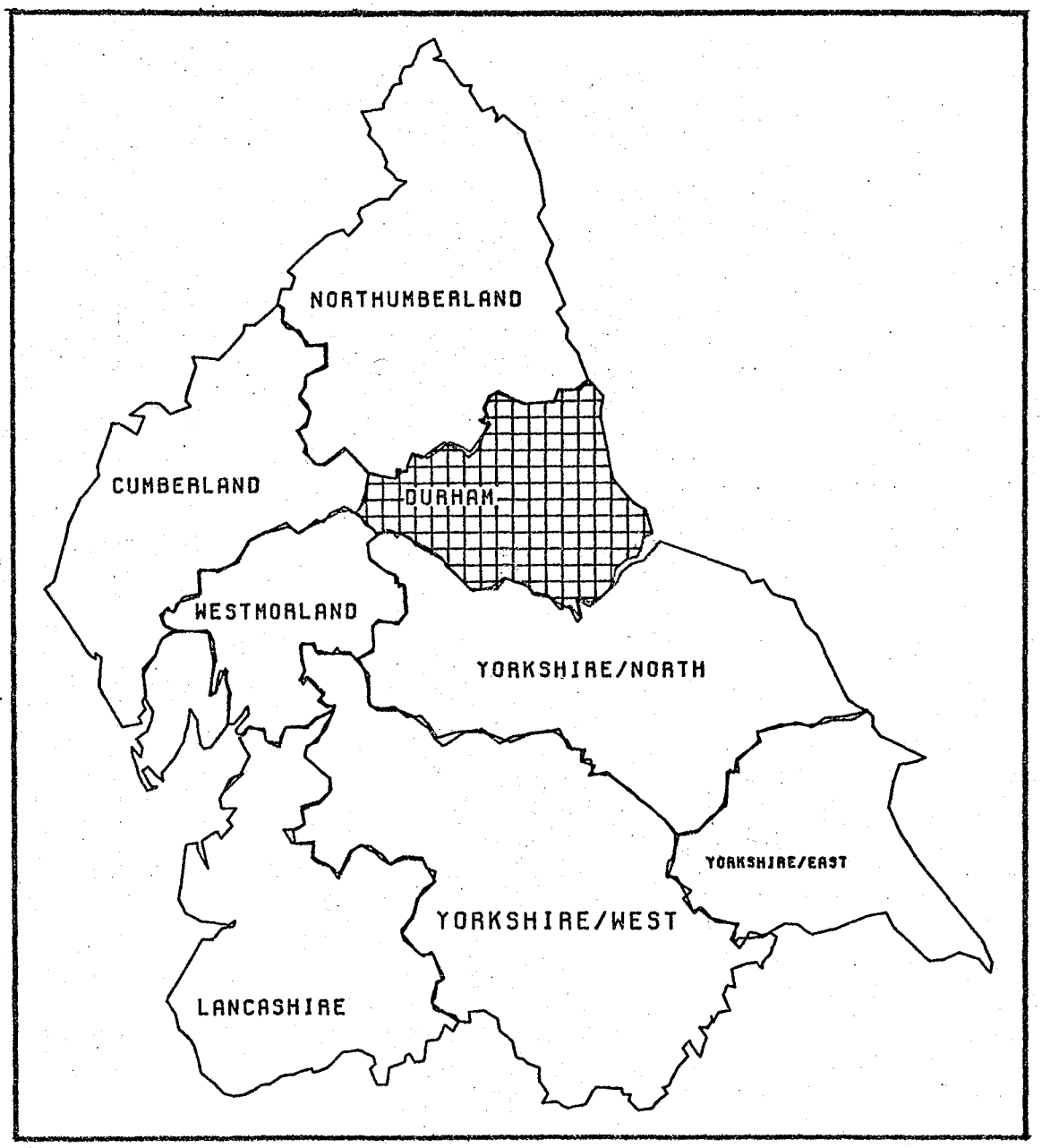
Chapter Three is concerned with the genetical theory behind the concept of gene flow, the modification of demographic methods to the needs of the anthropologist, and the use of the 'relatedness' technique in determining homogeneity. It also summarises other recent work done so that a comparison of results may be made.

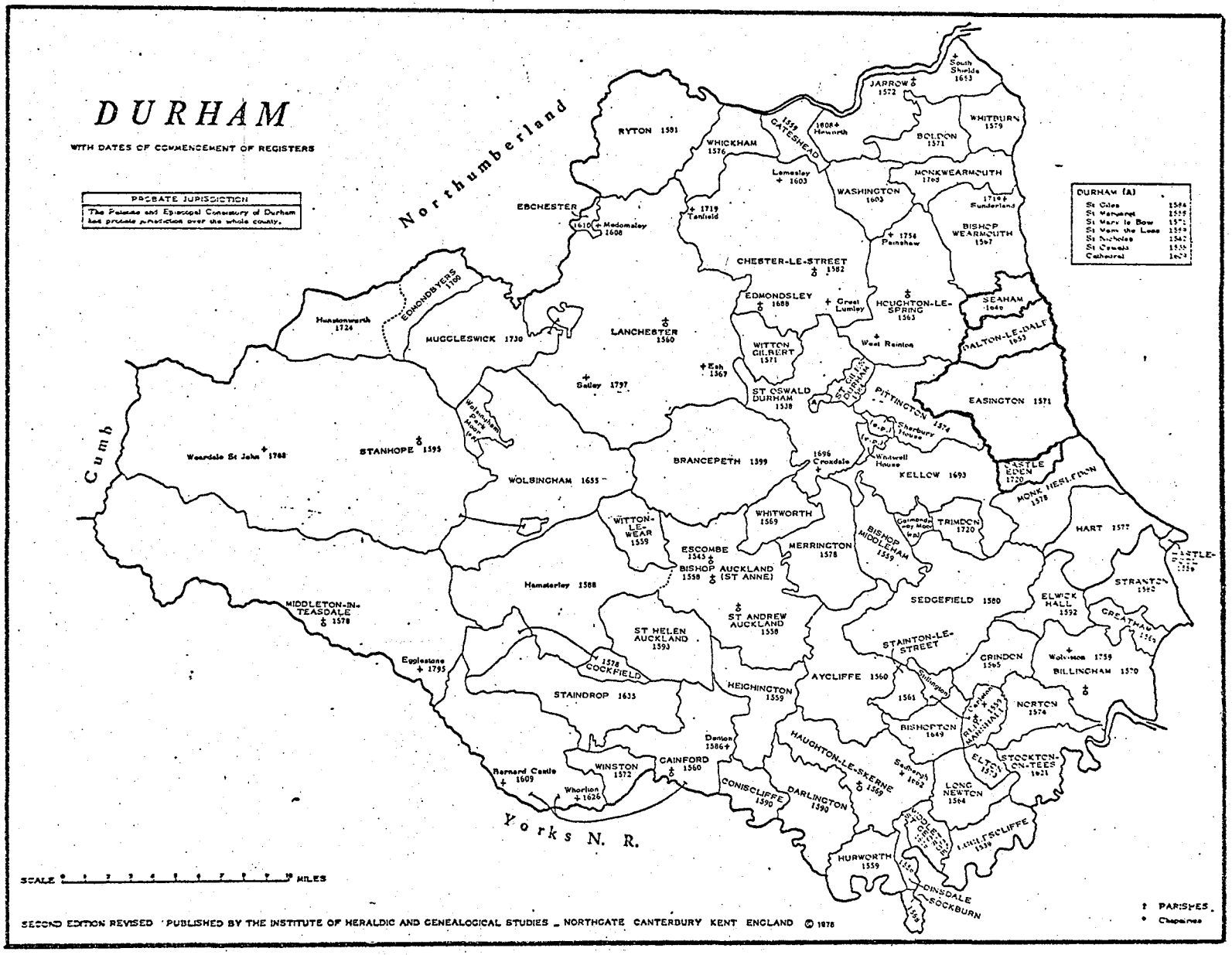
Chapter Four is a description of the data source, the problems found with the material, the methods of recording and the techniques of statistical analysis undertaken.

In Chapter Five the results of the analysis of the parish registers and census data are kept separate. They are then evaluated and compared in the discussion of Chapter Six and finally a conclusion is attempted in the same chapter.

Map 1.1 THE NORTHERN COUNTIES OF ENGLAND

Location of County Durham





Map 1.2: LOCATION OF STUDY AREA IN COUNTY DURHAM

CHAPTER TWO: HISTORICAL AND GEOGRAPHICAL BACKGROUND

GEOLOGY AND PHYSIOGRAPHY

Human settlement patterns and population distributions are partly a reflection of the physical conditions of a region. In combination with climatic conditions the geological structure of a locality will affect the potential for agricultural, pastoral and industrial usage through the differential distribution of soil types and mineral resources. The unusual physical features of the region under study have played a significant role in its development.

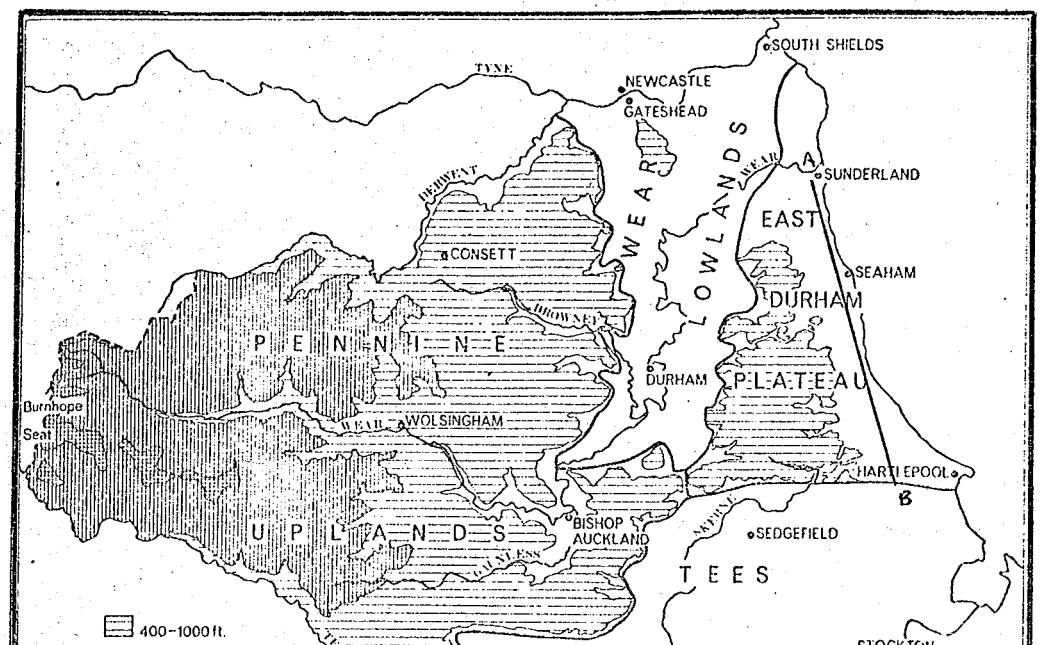
The study area lies on one of the four main geomorphological regions of Durham, the East Durham plateau (Brit. Ass. 1970; Map 2.1), a triangular area extending between South Shields in the north and a line running between Darlington and the Hartlepools in the south. The western edge of this Permian limestone escarpment overlooks the Wear valley from a height of 200ft; it is dissected by streams leaving spur-like extensions of Magnesian limestone jutting out. To the east of the escarpment, which attains a maximum height of 715ft O.D. in the extreme south west, the limestone plateau proper, covered by glacial deposits, dips gently towards the sea from 600ft to 50ft. The inhospitable

coast is characterised by formidable, steep cliffs breached by narrow, wooded streams or denes; for instance, Dalden dene between Seaham village and Seaham Harbour and the dene which separates the parishes of Easington and Castle Eden, the beautiful Castle Eden dene. In the south the scarp is cut by the Ferryhill gap, a late glacial overflow channel followed by the main east-coast railway (Brit. Ass. 1949).

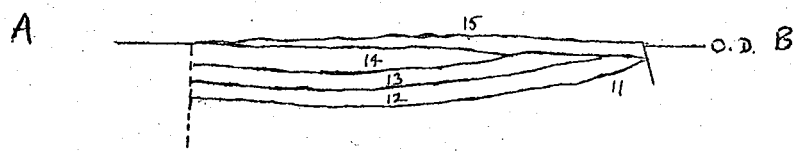
The barren (in mining terms) Permian sediments of the plateau, 700-900ft in depth, are composed of three types of rocks: a basal series of sandstones, the Yellow sands, which fill in hollows in the carboniferous surface; a thin layer of Marl slate lying below magnesian limestones; an upper series of red marls with associated rock salt and anhydrites. The important sequence of coal measures are found in the carboniferous sediments below. Smailes (1960) prefers to divide these deposits into lower carboniferous, containing thin limestone beds and seams, and the upper carboniferous which lacks limestone but is rich in thick, good quality coal seams, instead of the traditional three part division. The proven maximum thickness of the coal measures is 2,000ft. Pre-Carboniferous rocks of Durham are thin and only outcrop in Upper Teesdale.

MAP 2.1: GEOMORPHOLOGICAL REGIONS OF CO. DURHAM

(after, Beaumont, P. in British Association - Durham County and City with Teeside, 1970)



TRANSECT AB SHOWING GEOLOGICAL STRATA OF THE EAST DURHAM PLATEAU



KEY

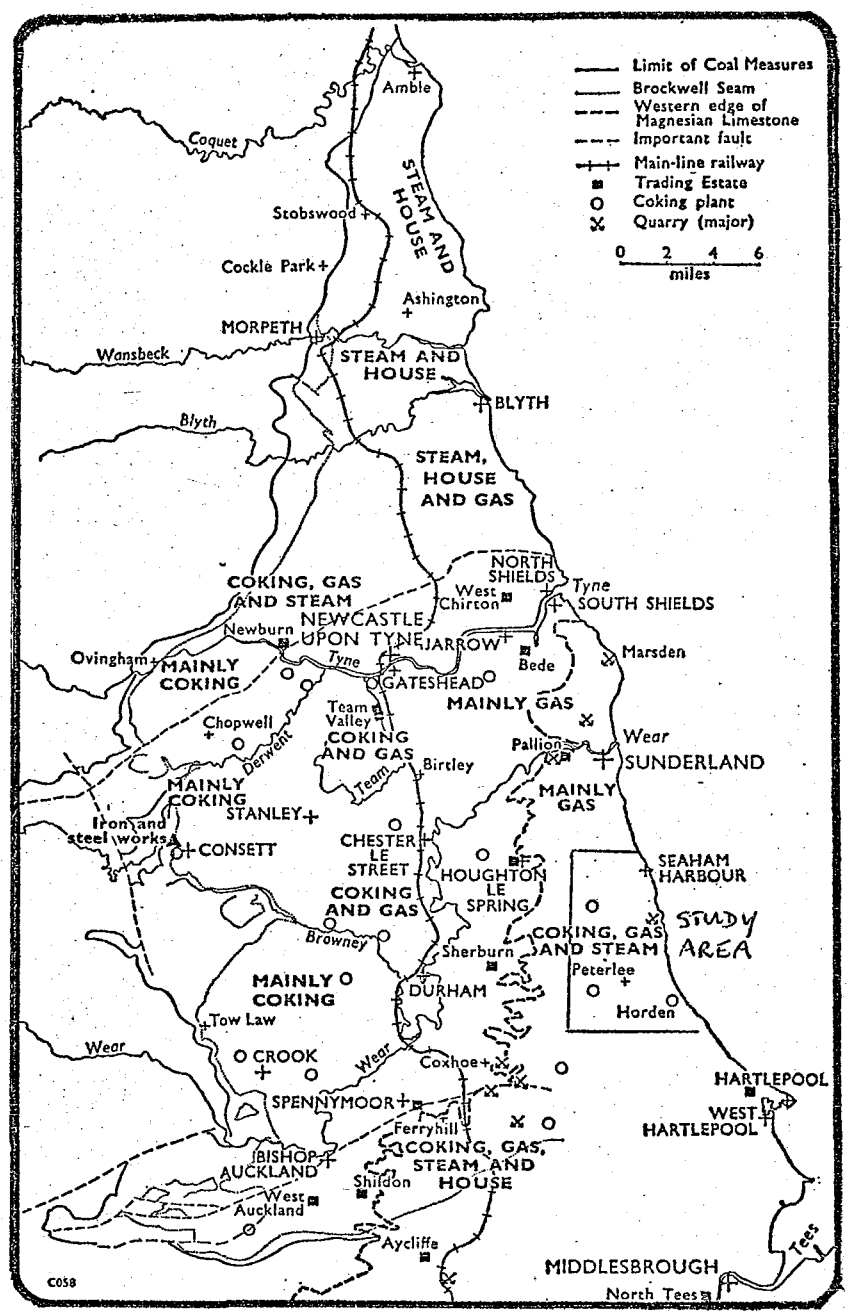
15	Permian	12	Lower Coal measures
14	Higher Coal measures	11	Carboniferous limestone series
13	Main Coal measures		

Coal Measures

The Durham and Northumberland coalfield is roughly triangular, lying between Amble and the Hartlepools (Map 2.2). West of the limestone escarpment the carboniferous deposits are exposed on the surface, facilitating mining operations; as a consequence, this area of Durham was the first to be industrially colonised. The main productive series from the Brockwell seam at the base to the High Main at the top contain approximately twenty workable seams of variable thickness and composition. East Durham coals yield high amounts of volatile fractions best suited to making gas. The most commonly worked seams of the collieries of the four parishes are the Main, Low Main, Hutton and the five-quarter.

Many igneous dykes intrude upon the coalfield interrupting the coal seams. Hett dyke is of particular significance to the study area. A basaltic intrusion, it traverses Durham coalfield, passing between Shotton and Haswell collieries, separating those of Thornley and Ludworth, passing Hett and finally apparently slips into the Butterknowle dyke. The Hutton seam of coal is much thinner and more expensive to work on the south side than on the north - as the owners of Shotton colliery found to their cost (Fordyce, 1857).

MAP 2.2: DURHAM AND NORTHUMBERLAND COALFIELD - SHOWING EXTENT AND COAL TYPES



(After Smailes, 1960)

Climate and Soils

As anyone who has moved from the South to Durham can testify, the principle features of the County's climate are the constant breeziness, chilly spring and cool summer, the strong northerly to easterly winds of the early part of the year and the cool summer breezes. It is basically similar to that of south-east Scotland. The coastal district is particularly cold in spring and early summer because of the cold North Sea waters, biting easterly winds and reduction of sunshine by cloud. The exposed location of Seaham Harbour is one of the major reasons it has never gained the prominence as a shipping port promised by its founder Lord Londonderry. Rainfall is the second lowest in the north-east, 25-30 inches annually and temperatures range between 20 and 80 degrees Fahrenheit.

Although Bailey summarily dismissed soil conditions in the study area as "poor unfertile clay" (in Moyes, 1972), there does exist a variation in soil types and fertility. Extensive glaciation over the eastern part of Durham left boulder clay on top of which lies middle sands, then an upper layer of boulder clay. Kelly (1858) briefly describes the soil types of the four parishes during the nineteenth century variously as clay, sand, and loam, able to support wheat, barley, oats, potatoes and turnips. A large part was also used for pasture.

AN ARCHAEOLOGICAL OUTLINE: NEOLITHIC TO ANGLO-SAXON PERIODS

Prehistoric Period

The most outstanding feature of the prehistoric settlement pattern of present day County Durham is the paucity of archaeological sites, even during the Iron age when a rich culture existed in southern Britain, but this may partly be due to a lack of intensive archaeological surveys in the region (Harding, Brit. Assoc. 1970). The evidence of the prehistoric period is mainly confined to isolated flint or metal artefacts, but a few places have yielded fairly substantial deposits; for example in the study area a site at Horden produced many arrowheads and scrapers; at Murton, two Neolithic hand-axes have been positively identified amongst an abundance of older lithics. The arrival of the Neolithic peoples was probably no later in this area than in the rest of Britain as has been previously suggested: a date in the early third millenium B.C. would be a fair estimate. Unlike neighbouring Cumbria, Durham does not exhibit megalithic architecture but some long barrows at Warden Law and Copt Hill, Houghton-le-Spring testify to the presence of Neolithic peoples on the borders of the study area.

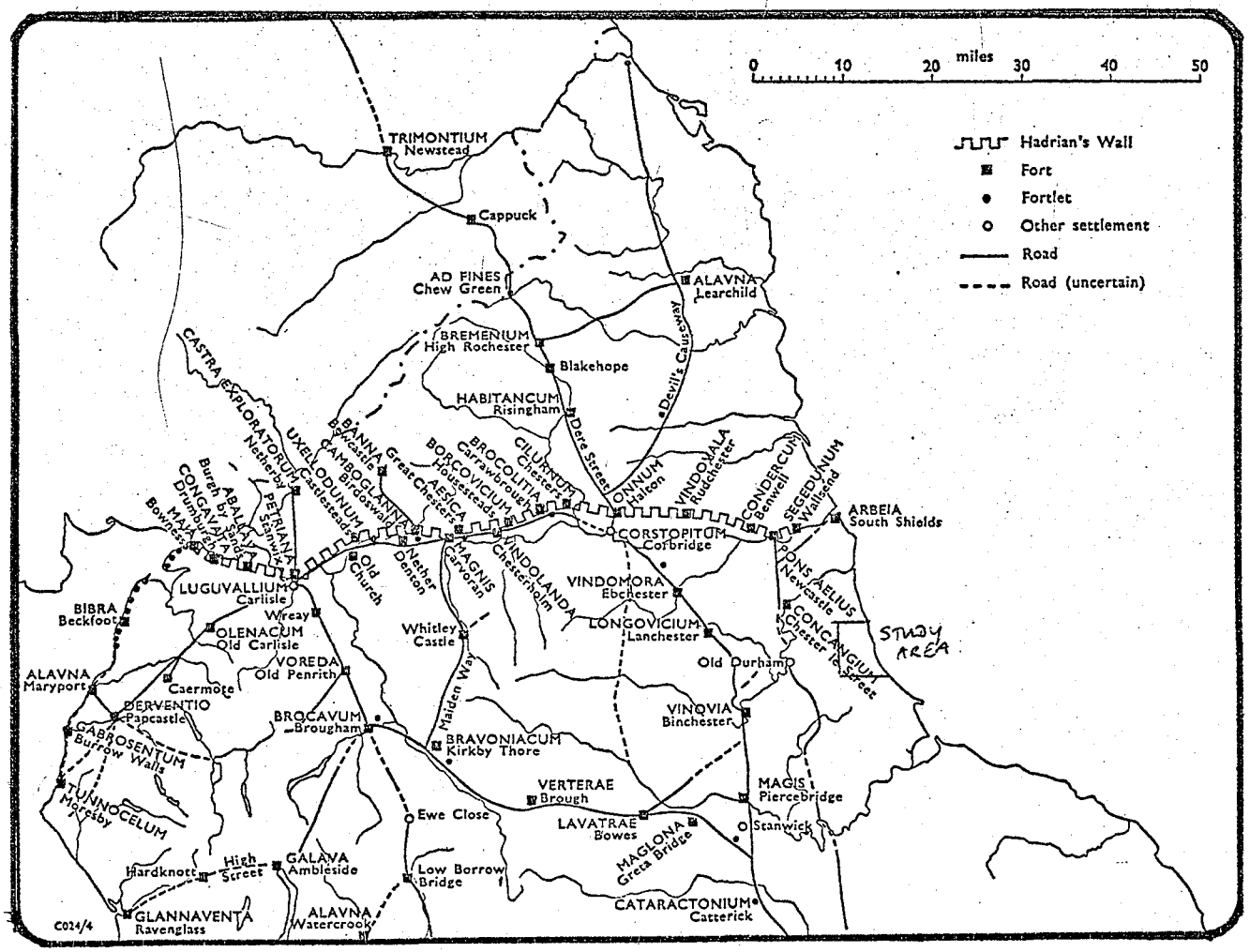
The copper age or beaker period shows a distinct boundary on the Tees valley between the distribution of stone-lined cist graves to the north and barrow mounds to the south. An example of the former was found at Crimdon to the south of the four parishes. The evidence from the Bronze age proper is limited to axes and weapons, and as for the rest of the country, settlement sites are almost non-existent. The late burial sites are also sparse.

Iron age settlement sites are notably few in Durham, which probably implies the presence of a nomadic pastoralist economy, typical of the Highland zone (Fox, 1926) - in contrast to the extensive, permanent farm-stead enclosures of the southern lowland districts. (The only representative being West Brandon.) Again, the many hillforts found north of the Tyne and other parts of Britain are absent in Durham indicating a lack of social cohesion. With regard to the Easington district Moyes (1969) comments on the lack of later prehistoric material. It seems fair to view the prehistoric period in Durham as one of continuity of culture, a period of little change in subsistence techniques over thousands of years, and of comparatively low population density (Smailes, 1960).

Roman Period

The Celtic tribes of the north confederated to form the Brigantian tribe met by the Romans when Agricola marched northwards. They were mainly concentrated in Yorkshire but southern Durham, at least, was probably part of their territory. The Roman period in this region is dominated by Hadrians Wall extending between the Tyne and the Solway with its concomitant roads, military garrisons and vici. Roman presence in or near the study area is restricted to some Roman buildings at Monkwearmouth and Seaton Carew, coins of the late Roman period at Seaton and a gold armlet found in the gardens of Shotton Hall. Dobson, (Brit. Assoc. 1970) suggests, on the basis of strategic location, that Seaham may well have been one of the Durham series of coastal signalling stations linking up with those of Yorkshire. The coming of the Romans seems to have had little impact on the lives of the Brigantia, at least, in terms of structural remains - this is certainly true of the study area.

The Anglo-Saxon invasions of Britain which began in the fifth century AD brought new immigrants to the north, and saw the emergence of the kingdoms of Bernicia and Deira which were later united to form Northumbria. The Anglian period provides documentation, to augment the archaeological material.



MAP 2.3: ROMAN FRONTIER ZONE IN NORTH ENGLAND - APPROXIMATE LOCATION OF STUDY AREA IN RELATION TO ROMAN SITES

THE CHURCH AS LANDOWNER

The majority of the rural villages of the eastern plateau extant in the nineteenth century date back to the Anglo-Saxon period, or before. All the village names of the four parishes, with the exception of Hawthorne which is British, are Anglo-Saxon in origin. Shotton, derived from 'Sceotta' and 'tun' means 'Scots village'; Seaton, not surprisingly means 'sea village, derived from the Anglo-Saxon 'sae' and 'tun'. The conversion of the Saxons to Christianity, made the church of St. Cuthbert. then at Chester-le-Street, one of the major land owners in Durham. However the position of eastern Durham in particular, exposed as it was to Viking raids, caused rapid changes in land ownership. Place-names show little indication of Scandinavian settlement in Durham and this is supported by archaeological data and historical sources. But written sources provide clear evidence of Scandinavian ownership. The south eastern villages of Esington, Thorep, Cealton, Yoden and Horeden were bought from Guthrum the Dane by Abbott Ethred in 882 to enrich St. Cuthberts Church, and in 915 AD, Bishop Cutheard granted these to Elfred, a fugitive from the West. The east coast then fell prey to another pagan king, Regnwald or Reginald, who partitioned it among his two lieutenants - Scula and Onlafbal. Simeon mentions Yoden (Castle Eden) as the northern limit of Scula's territory. The story goes that when the tyrannical Onlafbal was transfixed in the church for defiance of St. Cuthbert the Norsemen retreated

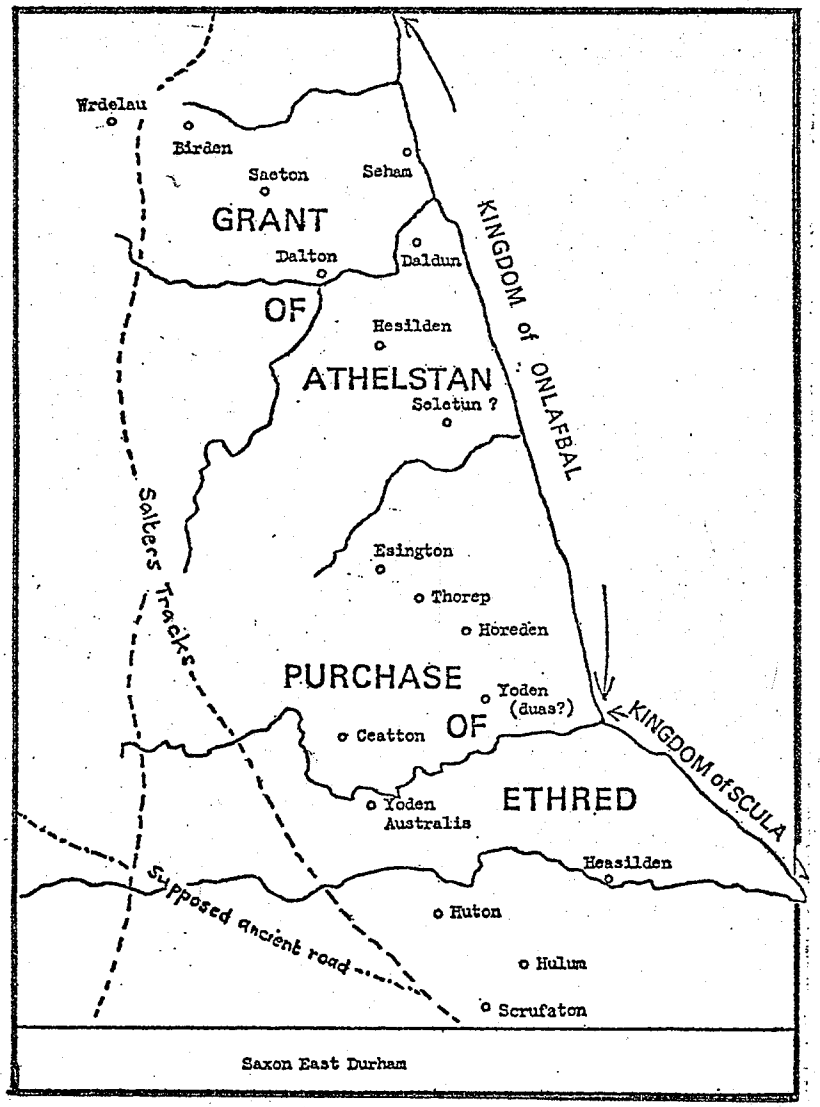
in horror. The land was returned to the church. In 930 AD King Athelstan augmented the Church's estate further by granting his lands in the Dalton-le-Dale and Seaham area to Bishop Wigred.

After William the Conqueror gained the English throne, Durham was caught between Norman oppression and the marauding Scots. The savage destruction of the villages and lands of the eastern plateau along with a large part of the bishopric by the Scots, forced William to appoint a Norman Bishop who was given the Earldom of Northumberland and all the priveleges of the Bishopric. He could keep his own mint, issue charters and levy troops. The main source of information for the area from this point onwards, comes from the bishops' charters, rolls and surveys (Moyes, 1969).

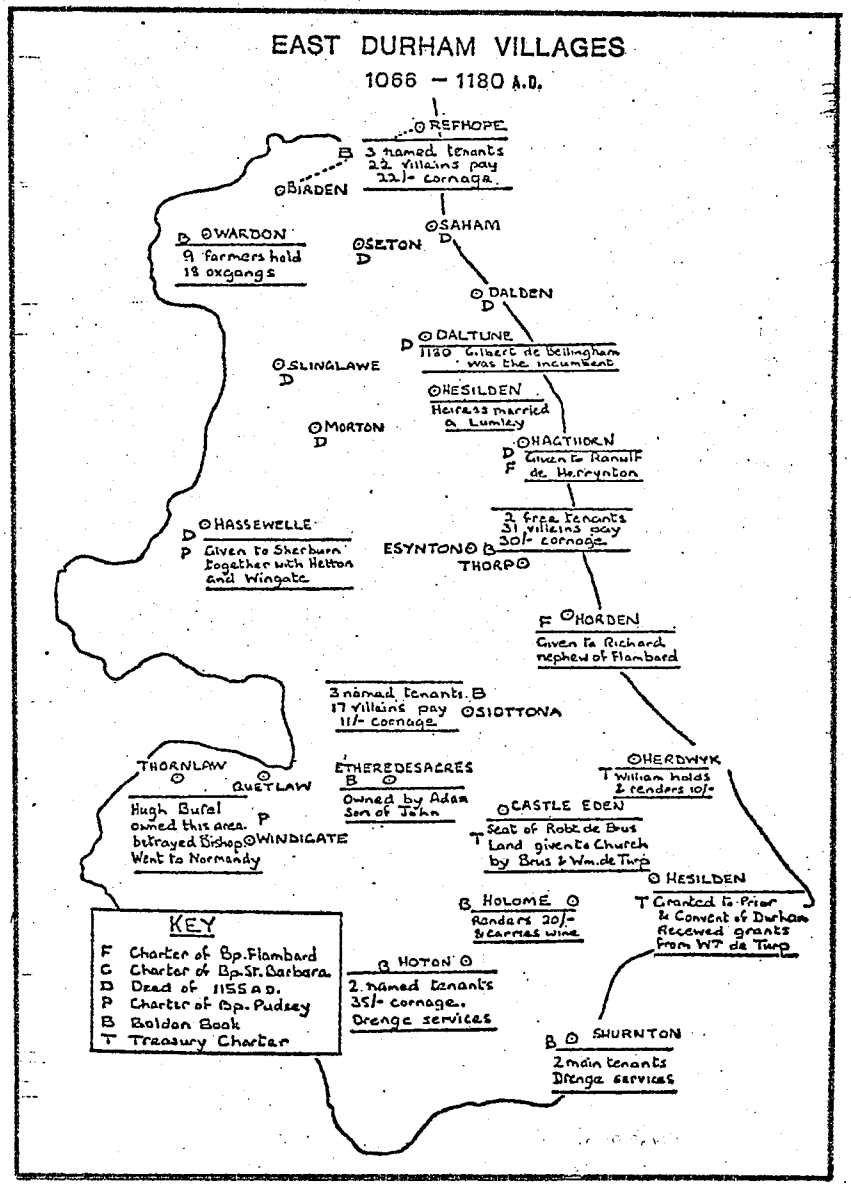
The first of these, a rental survey, was instigated by Bishop Pudsey in 1183. The Boldon Book as it came to be known presents a clear albeit incomplete picture of Norman village life and structure. The basic unit was the vill: the village with houses attached to the Lords Hall. Large, common fields surrounding the village were ploughed by the tenants who also held certain rights in the woodlands and moorlands, such as swine-feeding and pasturage. Smailes (1960) comments on the high frequency of pastoral vills in Durham, where payment was by 'cornage', in contrast to the great number of agricultural vills in the south of England. Pastoralism involved smaller, scattered settlements,

a persistent feature of the north. Of the villages in the study area mentioned in the Boldon Book, Esynton (Easington) was the most important with two free tenants, 31 villeins and 30/cornage rate. Siotton (Shotton) and Etheredacres are also mentioned. In 1155 the boundary between the Convent's lands in Dalton Parish and the freehold manor of Dawdon and Seaham had been fixed by a solemn deed and at the time of the Boldon Book the Lords of Dalden and Seham still held the baronial seat at Dalden Tower.

The fourteenth and fifteenth centuries were periods of devastation, plague and decline. Edward Ist's warring with the Scots placed Durham at their mercy when they took their revenge. In 1337 the Vicar of Dalton complained of the wasting of the land and depopulation in his parish caused by the Scots: "Previously fifteen villains and fifteen cottagers (lower class) paid tithes, now there were only five villagers and six cottagers - all in a state of near beggary and unable to pay anything to the vicar. Murton and Cold Hesildon were in the same state." (Moyes, 1969). Easington's population and value had also decreased for the same reasons and to make matters worse, with nearby Shotton, it suffered the excesses of the plague. Later to be called the Black Death, the plague advanced through Durham in the 1350's; twelve deaths were recorded at Dalton and eighteen at Hesilden - a severe toll on the few inhabitants of these villages.



MAP 2.4: STUDY AREA IN THE SAXON PERIOD
(After, Moyes, 1969)



MAP 2.5: STUDY AREA IN THE NORMAN PERIOD
(after Moyes, 1969)

Bishop Hatfield's survey of 1380 reports on the devastation and depopulation: "...more than five cottages in Thorp are without tenants ...sixteen cottages in Easington are without tenants.." (in Moyes, 1969). Of the villages owned by the Bishop, Easington was still the most important, nine freemen paid rent in lieu of services, there were 31 bond tenants and 16 cottagers paying rent and providing services. Land-holding by tenants was in a process of change, only partially complete by 1380, the villain would soon be able to acquire a copyhold right to the land. Combined with the Halmote rolls, the survey reveals differences in settlement patterns between the eastern plateau and the western area of Durham. Compared to the vale of Tees, the scarp edge of the plateau, and mid-Durham, the villages of the eastern plateau were few and widely spaced. They avoided the clay drift areas and kept to the patches of sand or the margins of the clay drift. The coastline itself was devoid of any habitation (Smailes, 1960). At this time not all of the study area was held by the bishop: Dalton was still in the hands of the Convent and Seaham, Seaton and Slinglawe (Slingley) were divided between the Yeland and Hadham families. By the beginning of the fifteenth century, the Yeland moiety passed into the hands of the Daldens.

The decline continued during the fifteenth century. Bishop Langley's survey records a decrease in arable cultivation, a reversion of arable and cottage land to the wild and the

deterioration of mills and forges. Evidence from the Bishop's registers indicate that poverty caused plundering and irreligion in the four parishes. Towards the end of the century many of the villages, including Cold Hesildon, Old Shotton and Edderacres, had either become completely deserted or had diminished notably in size and influence. Castle Eden was emparked.

TUDORS TO EARLY INDUSTRIALISATION

Order was restored in most of England and Wales by the political settlement of 1485, but the Tudor centralisation policy followed by the reformation and dissolution brought chaos to the Bishopric of Durham. Henry VIII abolished the priveleges of the palatinate and dissolved the monasteries after the show of defiance of the Pilgrimage of Grace. Land changed hands again, dissolution caused Dalton to pass to the state, but as there had been no monastery in the area, the lives of the ordinary people probably remained unchanged (Moyes op. cit.). However, the 1569 Rebellion affected all people. The gentry of the area (with the exception of the Bowes family who now held the seat at Dalden Tower) rose in support of Catholicism and Mary, Queen of Scots. The rebellion was a failure; many were executed including two of the six men of Easington who had taken up arms, while the Trollop family of Eden was forced to forfeit some of its estates. The old feudal system had now completely broken down and had been

succeeded by a new system within which land tenure was determined by cash rents and a greater number of freehold estates came into existence. Its remoteness from the centre of power favoured the growth of recusancy but the County was not remote enough to escape the return of plague, nor the agricultural distress that was prominent elsewhere and prompted the introduction of the Elizabethan Poor Law. In addition to these problems there was the constant fear of Scots aggression.

Declarations made by the people upholding the reformed protestant religion made during the Commonwealth throw some light on demography of the area. Moyes compared the names of all men over eighteen in Easington parish who subscribed to the Solemn league and Covenant of 1644 and 1645 and found great similarity to those in the rolls of Tenants of the Hatfield survey three centuries before, indicating that there had been continuity of residence. The restriction on movement resulting from the Poor law and the relative infertility of the eastern plateau were probably contributary factors to this continuity in the study area. These and later declarations also show the paucity of Catholics in the four parishes compared to other parts of Durham. There is evidence in the seventeenth century of a revival of agriculture and renewed attention to the land. This period saw the beginning of enclosure of common grazing lands, shared between freeholders, copyholders and leaseholders. Yeomen farmers were relatively wealthy as far as can be judged from

inventories of individuals but at the same time there was an increase in the poor labouring class.

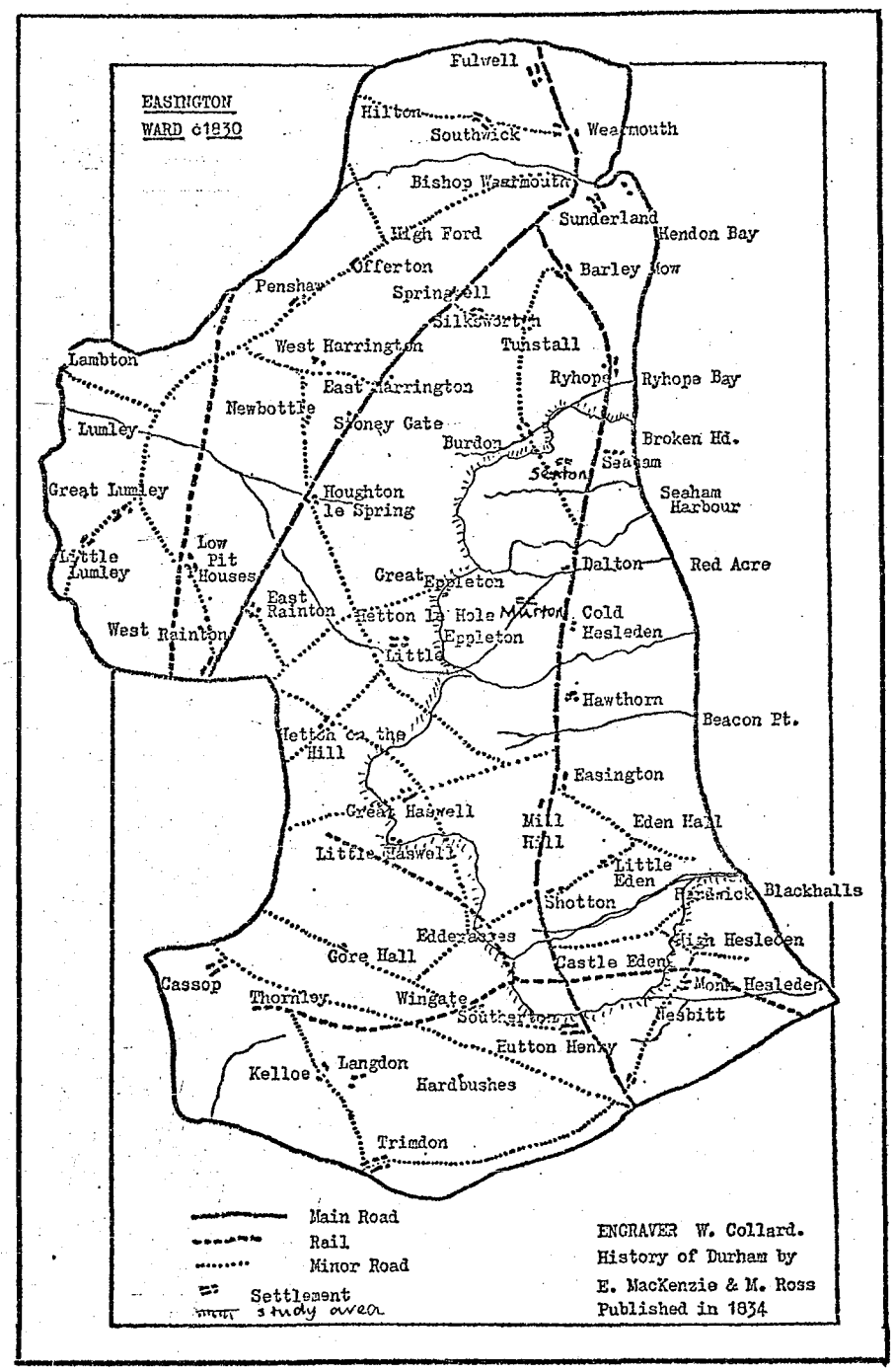
EARLY INDUSTRIALISATION: 18TH AND EARLY 19TH CENTURIES

Agriculture continued to dominate the economy of the four parishes in the eighteenth and early nineteenth centuries, but industrialisation began in the area in the form of a new port at Seaham Harbour and a cotton factory in Castle Eden. The Milbanke and Bowes families held the lands of Seaham and Dalden, Dalton was held by the Dean and Chapter and Castle Eden became the property of Rowland Burdon in 1758, a member of one of the most influential families of the area in the pre-mining phase. He rebuilt the Castle and church and enclosed the largely deserted lands of Castle Eden. His son, Rowland Burdon Jnr. was M.P. for Durham for sixteen years during which time he played a prominent part in the development of eastern Durham. He initiated the construction of Sunderland bridge which joined together two small, largely unknown villages of Sunderland and Wearmouth which developed into one of the largest and most important industrial centres of the north-east - Sunderland. He also promoted a turnpike road from Stockton to Sunderland which was the only highway for all the villages of the study area and main means of communication (see Map 2.6). The act for the new road was obtained in 1789. Three years later a cotton factory largely

financed by Burdon opened in Castle Eden. The baptismal registers record the changes in occupations of the inhabitants, now cotton spinners and weavers appear in addition to the traditional rural occupations of the parish. However industrialisation was shortlived, the firm moved to Durham city and the buildings were converted to a sailcloth factory which failed as a result of bankruptcy caused by French political problems of the early nineteenth century. The part of the parish that sprung up around the venture is known as 'Factory' today.

A glance at the early 1801-1821 Census figures for the area indicates the continuing low density of population. The inhabitants were the gentry, house servants, farmers and their servants and a large number of day labourers. Despite the lack of motorised transport the population was probably not as static as is often thought at this time. The annual hiring fairs may well have encouraged movement while the daily village auctions which provided jobs for the majority of labourers may have encouraged some exchange between villages. Early directories contain lists of inhabitants which show the same continuity of habitation noted earlier. In Easington village many surnames were the same, though the spelling may have changed, as those of the 1645 protestation (Moyes, op. cit.). Stage-coach communication was in a north-south direction, with staging posts at Easington and Castle Eden. Also carriers from Stockton, Sunderland and Hartlepool formed a network of contact between

MAP 2.6: VILLAGES OF THE STUDY AREA IMMEDIATELY BEFORE MINING



(Taken from Moyes, 1969)

villages.

Seaham Harbour: A Londonderry Enterprise

In 1808 Seaham was, according to a Mrs. Smith (Memoirs of a Highland Lady, 1898), a most primitive hamlet, a dozen or so cottages, no trade, no manufacture, no business; owners were mostly the servants of Mr. Milbanke and apart from the Clergyman's family there were none of the gentler degree (Seaham Community, 1978). The most outstanding event to occur here was the marriage of Lord Byron on January 2nd, 1815 to Miss Isabella Milbanke at Seaham House which is recorded with much pride in the register of St. Mary's church, but sadly the marriage did not last for long.

It is not surprising then that the Durham Advertiser reported with wonder at the new town of Seaham Harbour that had sprung up half a mile away in 1831:

> "The surprise and astonishment of those who had attended the ceremony of the laying the foundation stone on 28th November, 1828, were extreme on beholding the wonderful transformation which had taken place in such a short period - the dry land on which they then stood was now excavated and the vessels were moored in safety, ... and

> a town had sprung up which has now nearly 1000 inhabitants, who have found a "local habitation and a name" where two short years ago there was not even a single cottage, and hundreds and thousands have received occupation and employment where the sound of the workman's hammer was never heard before" (D.A., 25/7/1831)

The venture had been initiated by the enterprise of one individual, one of the most energetic and flamboyant characters of the north-east, half-brother to Lord Castlereagh and husband to the heiress of a vast coalmining fortune - Charles Wiliam Vane-Tempest Stewart (later Lord Londonderry). Sir Ralph Milbanke had been the first to envisage a bustling, important harbour at Dalden Ness, a deserted rocky cove that would transform his Seaham estate. His agent had realised the effect the mining project at Hetton (the first attempt to win coal from under the limestone) would have on the importance of Seaham. (Sturgess, 1975). Plans were drawn up for 'Port Milbanke' but the idea had to be dropped when Milbanke fell into financial difficulties and was forced to sell his estates to Lord Londonderry in 1821. The Marquis knew of the proposals and decided that a port here would be ideal for shipping coals from the Vane-Tempest mines in Pittington and Rainton. Londonderry's agent set to work; William Chapman, a well-known engineer was commissioned to extend his original plans for Milbanke's harbour

and the famous Newcastle architect, John Dobson was asked to design the town. Londonderry envisaged a large, industrial centre and town that would do credit to his name. Dobson produced a remarkable scheme, a main street flanked by two crescents facing the sea; three classes of houses would be constructed, the first class in the south crescent the "quality end of town" (letter to Londonderry, Oct. 1828, in Hughes, 1965) with six rooms, the second class in the north crescent (four rooms) and cottages along each side of the railway. The Marquis was pleased by the idea but did not have enough financial backing to spare for this grand design. He chose the more lucrative method of leasing ground to individual builders to do with as they pleased within the general Dobson framework: "Let every entrepreneur follow his fancy and taste" (quoted in Sturgess, 1975). Alas for Seaham Harbour, the uniformity of construction was lost and little of Dobson's scheme survived. Ambitious ideas such as running water for every dwelling were soon forgotten and houses were built in a random fashion.

In contrast, construction of the harbour was carried out in much the form Chapman had planned. By July 1831, the harbour was still incomplete but capable of loading ships. The first, 'Lord Seaham', transported coal that had come from Rainton via the new railway. 388 vessels were loaded in the first six months and Seaham Harbour appeared to be well on its way to becoming a challenge to Sunderland as the most important import and export

harbour of Durham City, as intended by Chapman (Pattendon, 1972). As the local workforce was totally inadequate to cope with the employment opportunities, a flood of immigrants arrived; Dalden, the southern part of the new town, increased its population by 340% between 1821 and 1831 from 35 to 1022 and in the following decade the population doubled. The little hamlet of Seaham, huddling around the church remained a separate entity in Seaham Parish while Seaham Harbour was to become first a Chapelry of Dalton-le-Dale then a Parish in its own right in 1847. Map 2.6 summarises the villages and townships existing in the study area in this period, immediately before mining.

COAL-MINING: 1831-1876

The introduction of mining in the study area is best viewed against the background of the development of the coal industry as a whole. Commercial exploitation of the Durham and Northumberland coalfield was at least six hundred years old, if not older considering the evidence of Roman mining attempts at Benwell. Records of 1239 give the first undoubted evidence of mining: King Henry III granted to "the good men of Newcastle licence to dig coals in the common soil of the town ...and from thence to draw and convert them for their own profit..." (quoted in Fynes, 1923). But development of the coalfield was slow until the middle of the sixteenth century when wood resources became

desperately low and prejudice against coal-burning was dispelled thus creating a heavy demand in London and other urban districts (Smailes, 1935). Mines were mainly concentrated around the Tyne and, later, Wear rivers to facilitate sea transport which was much less costly than that by land. As waggon-ways were built and mining techniques improved, deeper mines in the Wear district further inland were sunk and the Hutton seam exploited for quality household coal. Exploitation of the south-west corner of the coalfield had to wait until the opening of the Stockton-Darlington railway in 1826 which gave an excellent outlet for land-sale mines and made them a profitable proposition.

The winning of Hetton Lyons colliery at Hetton-le-Hole in 1822 by John Buddle, the foremost mining engineer in the country, dismissed once and for all any doubts that coal was to be found under the limestone and caused the rapid alteration of the eastern plateau from small dispersed rural hamlets to a large populous industrial complex of colliery towns. The local workforce was inadequate in numbers and inexperienced in industrial work to fill the huge number of employment opportunities that now appeared, thus began an influx of migrants from Durham, Northumberland, Yorkshire and other parts of the country "swamping" the rural population.

Many difficulties and problems were encountered and overcome in the winning of these collieries. The coal companies at Haswell and South Hetton began sinking at the same time but quicksand held up the operation in Haswell. South Hetton was one of the first pits to utilise the new port of Seaham to ship its high quality coal to London where it was known as "South Hetton Wallsend." The same company also sunk Shotton Grange on the south side of the Hett Dyke, but as the Hutton seam was thin and inferior the five-quarter seam was mainly worked. It made little profit until the Hutton seam could be reached by breaching the dyke, and finally closed down in 1876.

Dalton-le-Dale boasted one colliery at Murton, which posed the most difficult engineering problem of all (Fordyce, 1854). The first two shafts were begun in 1838 but water was met at 32 fathoms; a third shaft was commenced utilising expensive pumping and winding engines and finally five seams of workable thickness were found. The expense of the operation, borne by the South Hetton coal company, necessitated continuous working in order to be profitable, making Murton the first mine to establish shift-work.

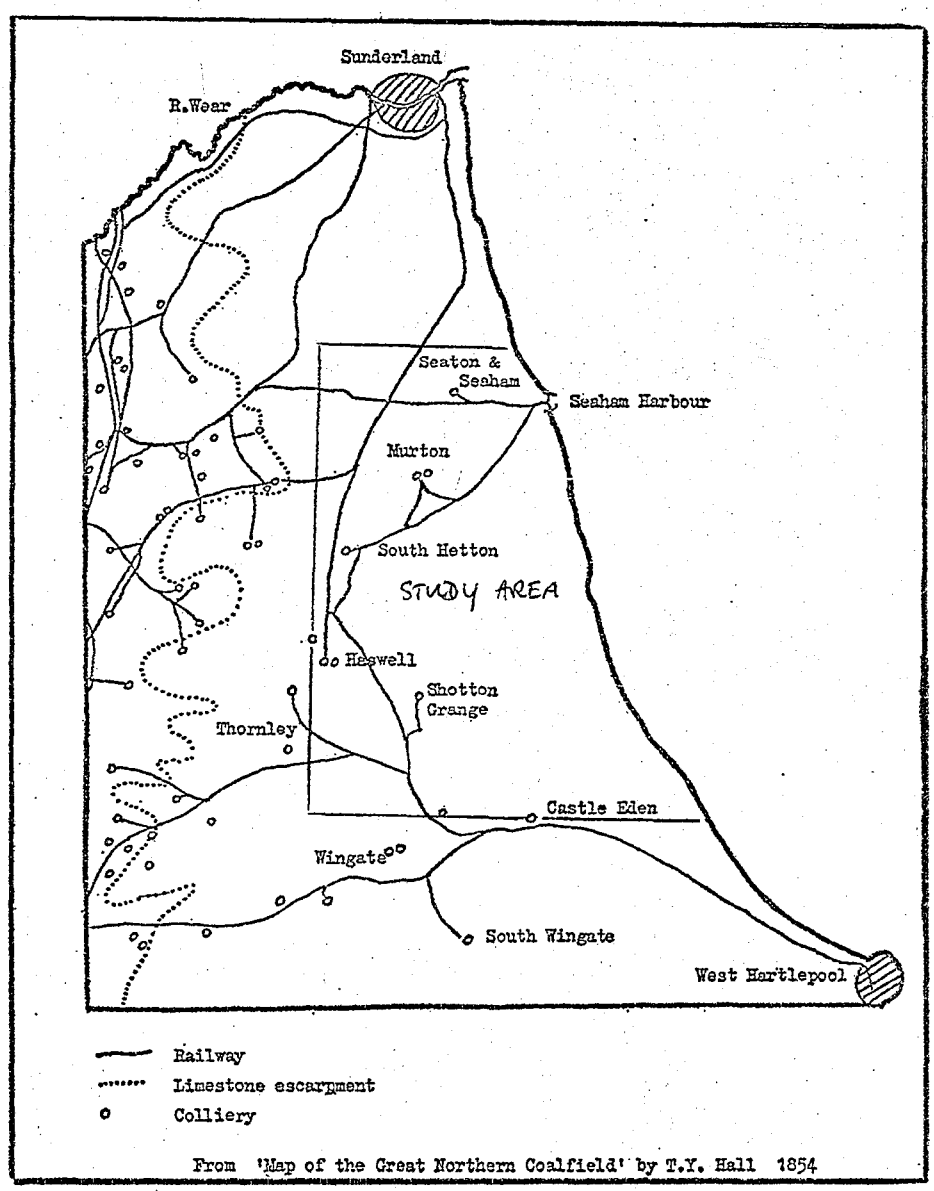
Coal was first drawn in Seaham Parish by the Hetton coal company at Seaton Colliery. Seaham colliery which began shipping coal later in 1852 was owned by Lord Londonderry and was located very close to Seaton colliery. The two were united in 1864, when

the Hetton coal company sold out to Lady Frances Anne Vane-Tempest, after legislation was passed making it compulsory for a mine to have two shafts.

A colliery was sunk at the eastern extreme of Castle Eden in 1840, but the colliery village was located on the other side of the parish boundary in Monk Heseldon, so mining played little part in the economy of the parish, which remained predominantly agricultural. A brewery, small engine manufactory and ropery were established at different times and for varying durations, but only the brewery remains today.

Each mine-shaft promoted the growth of a settlement around it composed almost entirely of coal-miners and their families, which developed as separate entities from the rural villages whose names they borrowed. A contemporary observer testifies to the transformation :

> "Within the last ten or twelve years an entirely new population has been produced where formerly there was not a hut of a single shepherd, the lofty steam-engine chimneys of a colliery now send their columns of smoke into the sky, and in the vicinity a town is called as if by enchantment into immediate existence..." (quoted in Smailes, 1960).



MAP 2.7: COLLIERIES IN THE STUDY AREA
(after Moyes, 1969)

Dates of Sinking:

Seaton Colliery	1844
Seaham Colliery	1849
Murton Colliery	1838, 1840
South Hetton Coll.	1831-1833
Haswell Colliery	1833
Shotton Grange	1841

(From Dowding, 1972)

The difficulties and expense of sinking these mine shafts affected the distribution and density of their communities. Unlike South-west Durham where the accessible outcropping seams favoured small, dispersed settlements the larger working area of the eastern mines resulted in larger, compact but separated settlements (Smailes, 1960). Map 2.7 shows these colliery villages at Shotton, South Hetton, Haswell, Murton and New Seaham. As the populations expanded, new parishes budded off from the original four: Shotton in 1854, South Hetton in 1863, Haswell (1869), and New Seaham in 1861. Seaham town, as it is known today grew from two foci, Londonderry's new town at Dawdon and the mining settlement around Seaham and Seaton collieries.

Mining life

> "The miner's lot included very long hours of labour with short hours for rest. No standard age was then fixed for boys entering the pit but they were sent to work as early as six or seven years of age not as is sometimes alleged from mere heartlessness on the part of the parents but under pressure of growing family needs which was very keenly felt in my early years owing to the long continued low rate of wages and the high price of provisions." (G. Parkinson, 1912)

> "Our men have steady work and their earnings are sufficient to enable them to live comfortably. Their houses are very good and there is a garden ground for as many as will choose. All in fact have gardens; many keep pigs. The houses are not crowded. we keep everything clean, carting away all the ashes etc. There is very little disease." (Quoted in Moyes. 1969).

Much has been written about the severity of work in the pit and the poor living conditions that were provided by the employers and there is little doubt that the commissioners official reports, such as the one above, presented a completely false view of the pit villages. A more honest assessment was made in 1859, when the report recorded complaints made of the inadequate accommodation. Rows of houses were still being built back to back, with no ceiling for the bedroom so the pitmen had to sleep directly under the roof slates in all weathers. Despite the bias in the reports, working conditions in the pits were probaby a little better in the Northern coalfield than in other parts of the country. By the time of the 1842 Coal-mines Act, women had long since stopped working in the pits of the north-east and safety precautions were the best in the country. Nevertheless, there were many accidents in the pits of the study area. Haswell suffered the most devastating explosion in 1844 when 95 men and boys were killed. The closeness of mining communities is well demonstrated by an explosion at Murton four years later when 12

of the 14 men who died came from South Hetton. The two collieries, owned by the same company and situated less than a mile from each other were regarded as sister collieries.

There are many instances in the literature of regarding miners almost as a separate race who indulged in bad language, gambling, brawling and drinking (Abbott, 1965). A contemporary account described the pitmen as "rude, bold and savage set of beings apparently cut off from their fellow men in their interests and feelings. The pitmen have the air of a primitive race." (Quoted in Moyes). But Fynes (1923), contends that "the pitmen of Northumberland and Durham were by no means remarkable for their savagery and if many of them exhibited a love of cockfighting .... they were not singular in their tastes, but they had both example and precept from many who assumed to be their superiors." Reports of their separateness were probably exaggerated but were based on some truth. The nature of mining made the pitmen fairly distinct from other labouring classes and they were 'clannish'. The same contemporary observer above states: "They marry constantly with their own people from generation to generation, family has united with family until their population has become a dense mass of relationship." The 1846 report adds: "They marry at about 20 on average and always colliers daughters; they are very clannish.....".

Early marriage and high fertility is a common contemporary comment on nineteenth century mining communities and has been attested in studies of demographic material from coal-mining districts. Cairncross (1949) found that colliery districts had the highest rate of natural increase from the 1850s onwards. Friedlander (1972) and Haines (1979) both concluded that the special conditions of mining employment, such as short male working life, relatively high earnings peaking at an early age (hewers as most skilled were paid the highest wages, but could only carry out the heavy work in the prime of life), and a lack of employment for women were the major factors influencing high fertility.

Haines considered the Durham and Easington Registration districts together and found that crude birth rates averaged 24.4% higher than for England and Wales in the latter part of the century and female marriage was early and extensive. A surfeit of men in new colliery districts lowered the age at marriage for women and decreased the number who never married but the men's age was no lower than the national average. High fertility amongst miners seems to have affected other occupations, fertility indices of farmers were much higher in mining areas than in predominantly agricultural districts. Early age at marriage was not the only factor increasing fertility, Friedlander's analysis of the 1911 age-specific fertility tables showed that miners still produced one additional child per family

on average when controlling for age.

Methodism

Methodism became a major force in the lives of the northern miners. Wesley often preached in the coalfield and circuits were established all over Durham by the end of the eighteenth century, but a later sect established by Hugh Bourne, a mill-wright from Stoke-on-Trent took a strong grip on the mining population (Steele, 1968). The Primitive sect, as it came to be called, with its open-air meetings attracted the colliers because "it has more than any other sect, represented the democratic and progressive side of religion." (Burt, 1882). Primitive Methodist philosophy extended to practical aid for improving the living standards and political status of pitmen. There were complaints that the preachers stirred up the miners to violence and rioting in the 1846 report but the general consensus of opinion was that Methodism was a calming influence, discouraging drunkeness and bad language, and the same report conceded that "the improvement that has taken place within living memory in the habits of the collier and mining population is greatly attributed to their (Methodist) exertions." Their skill in oratory and organisation enabled Primitive Methodists to play a prominent part in the formation of Trades Unions and the Labour Movement. The Methodist working ethos encouraged men to move out of the

pits into less manual occupations (Taylor, 1969). The strength of the Methodist movement and comparative weakness of the Anglican church can be gauged by considering the number of chapels in the study area (Table 4.2) and comparing seating space in the 1851 Census of Religious Worship: the ratio of Methodist to Anglican seating space in England and Wales as a whole was only 1:0.41, in Durham it was 1:1.24 (Cooter, 1972). Although this census has been much criticised for its unreliability the evidence for a strong dissenting community in the study area is overwhelming.

Miners and mobility

House's (1959) general evaluation of population trends in the north-east emphasises the great increase in population in the decade 1831-1841, when migration made its greatest contribution (20% increase, 9% by migration); the the greatest numerical increase was in the period 1861-1871 but migration formed less than a third of its total of 24%. Up until the 1880s there was a shortage of labour in the region therefore a net inflow of migrants which was then reversed.

Although long-range migrants tend to be more prominent in the literature, most movement was clearly over short distances. Redford's (1935) distinguished text on labour migration in

Britain during the nineteenth century concludes:

> "The great majority of migrants went only a short distance, and migration into any centre of attraction having a wide sphere of influence was not a simple transference of people from the circumference of a circle to it's centre but an exceedingly complex wave-like motion."

Redford was writing of the country's population in general but regional work, on the northern coalfield's population (Smailes, 1938) and on the first plateau mining settlement at Hetton-le-Hole (Sill, 1978, & 1979) supports this view. Smailes presents a very coherent argument for the close correspondence between the destructive nature of mining and short-distance migration. He envisages a cycle of population in a mining settlement. The first stage is youthful, characterised by a rapid increase in population by immigration; next natural increase tends to dominate and immigration slackens; emigration begins in the third phase because natural increase produces an excess of labour and finally a decline sets in as the coal is exhausted. A nearby mine that has not passed its peak will attract the outflow. "Such short-distance migration has been a prominent feature of the population history of this coalfield."

Emphasis on cyclical trends was also expressed in the case-study at Hetton-le-Hole which is a detailed analysis of patterns of mobility based on the enumerators returns of 1851. Changes in the mining population "accords closely with the contemporary vicissitudes of the coal-mining industry in Northumberland and Durham." Immigrant heads of households mostly originated from other parts of the coalfield - the mid-Wear and lower Tyneside districts (76% of those born in Co. Durham). Combined with an analysis of children's birthplaces this work produced convincing confirmation of complex, short-range migration from declining areas to newly exploited ones. This study also indicates the low numbers of migrants from a purely rural background which is in accord with the oft repeated statement that miners were geographically very mobile but occupationally immobile, leaving little opportunity for outsiders:

> "Son followed father into the local pit, and indeed, there were many "concessions" in employment for the father of large families who could supply able-bodied lads for the mines." (House, 1959)

The annual bond, often the source of much grievance was also probably an influential factor in miner's mobility. This was an agreement signed by owner and employee that guaranteed work in

the pit for a year. A good system at first, it ensured work for the miners and a steady labour force for the owners, but it became abused by the latter who drew up long, complex clauses setting fines for absenteeism but offering no compensation when men had to be laid off through no fault of their own. Binding time in the early nineteenth century was accompanied by much drinking and other inducements to sign, but later the owners formed a cartel and agreed to limit the binding money. Their abuse of the system came to a head in 1810 when the binding time was changed from October to Christmas when the coal-trade was slack. This change would have been awkward for families moving homes in the dead of winter and would have lowered working conditions as labour supply exceeded demand at this time of year. A strike ensued which was partly successful, the binding time was moved to April, the same time as annual hiring fairs in rural occupations. In 1826, standardisation of the bond resulted in a single printed sheet for use by all collieries in the northern coalfield. Later a monthly bond was introduced as a slump in the coal-trade made it difficult for the coal-owners to give employment for a whole year but pressure by the workforce finally caused the abolition of both the annual and monthly bond in 1872 (Hair, 1965).

Long-range migrants

There is little doubt that long-range migration did play a significant part qualitatively, if not quantitatively, at different times in the development of the region. Being comparatively near, it is not surprising that the Scots were the first to arrive in Durham and documents recording vagrancy in 1823 (Redford, op. cit.) show their early influx to Durham; only Scots are recorded, no Irish at this time at all. Many keelmen, on the Tyne and Wear, who formed a colourful, distinctive group, were of border origin and such names as Acheson, Cruickshanks and Robson are common in Durham (Rowe, 1969)

In the 1860's, a heavy influx of Cornish families moved into the coalmining districts after the collapse of the tin-mining industry. A strike in 1865 at Murton colliery initiated the "Cramlington influx" of 300 men and families from Cornwall and Devon followed by 128 men, 111 women and 248 children (Abbot, 1964). A part of the colliery is still known as "Cornwall" today which might suggest that they tended to congregate together and perhaps formed a close social group.

Strike-breaking as a cause of long-distance migration is recorded with much bitterness but it is unlikely that such migrants were very numerous. There were instances of fighting, as at the Seaton Delaval colliery because some Welsh-men were

brought in as strike-breakers (Fynes, 1923) but it is also recorded that many of them returned home once they realised that they had been misled about the employment opportunities by the coal agents. Lord Londonderry was guilty of bringing in Irish from his estates in County Down during the great 1844 strike to man his pits at Pittington and Rainton but his only colliery in the study area, Seaham colliery, was not yet open.

Irish migrations

Irish migration to Britain in the nineteenth century is well-documented as the Irish met with suspicion, prejudice and ill-feeling in much of the country. Their different religion, language and extreme poverty alienated them from the local population so they tended to congregate in the worst city slums, employed in the most degrading work. As most were Catholics it might be expected that they formed close-knit populations, with little intermarriage with other groups and certainly this was the case in much of Britain. However, Cooter (1972 & 1976) claims that the Irish influx into Durham was not accompanied by the same degree of prejudice or maltreatment but they were tolerated and even regarded with sympathy. Large communities did exist in the urban sprawls of Newcastle (Sandgate was an infamous slum area) but in the smaller villages and towns of Durham they were probably better integrated with the local inhabitants, although

religious and social factors still held them together. One of the major reasons for this unique toleration of the Irish was that they were not in a position to compete with the local population for employment. They were not skilled miners, indeed, the Irish only made inroads into mining late on in the century, they tended to take the less-skilled surface jobs in mines, rail-labouring and other undesirable occupations.

Irish movements into Britain began in the late eighteenth and early nineteenth cenuries with seasonal migration to agricultural districts such as Scotland, the southern counties and the north-west (Kerr, 1942). It is unlikely that they would have found their way to the north-east after disembarking from the main ports of Liverpool and Glasgow, especially as they were eagerly awaited in many of the southern counties where there was a summer shortage of hands. Indeed, the vagrancy records already referred to indicate the lack of any Irish vagrants in Durham in 1823, and therefore the low numbers here.

The greatest movement from Ireland occurred after a series of disastrous potato famines in the 1840's. The decade 1841-1851 showed the greatest increase in Irish-born in Durham and Newcastle from 1.6% to 4.5% of the population (Cooter, op. cit.). By 1860 Durham held the fourth largest number of Irish in England and Wales but inspection of the figures in Poor Law districts shows Easington to have had relatively few Irish. It ranked

eighth out of 12 in numbers of Irish in the 1851 census (2.8% of population) and seventh out of 13 in 1861 (4.8% of population.) In each case the greatest concentration was around Durham City which was a strong Catholic centre. The low numbers in the study area can be accounted for by the failure of the Irish to gain mining employment. Seaham Harbour with its more attractive diversity of employment, did attract a fairly substantial Irish community. In 1851, they were concentrated in William and Henry Streets on either side of the railway. Those born in Ireland comprised 5.5% of the total population of the town; their households were large because many young Irish-men lodged with families which were on average smaller than other inhabitants. They were mainly employed in the docks, foundry and on nearby farms as labourers (Sturgess, 1980).

Their numbers in 1862 can be estimated because of a survey instigated by Lady Londonderry to determine whether the size of the Catholic community warranted a church. (In such a new town it is fair to assume that most Catholics were of Irish descent.) 475 lived in Seaham Harbour, itself, none in Seaham colliery and 58 (men, women and children in this case) lived in Seaton Colliery. Incidentally the Marchioness of Londonderry has the dubious distinction of being one of the few in Durham to exhibit anti-Catholic, anti-Irish feelings. The Catholic community had to wait until she died before a Catholic church could be built in Seaham Harbour, in 1870. It appears that the Irish were

prominent in shipping and in the glass-works of John Candlish of Seaham Harbour at this time (Cooter, op. cit).

Of the long-range migrants the Irish were certainly most significant but even they formed a low proportion of the population in the coal-mining districts and apart from Seaham Harbour they were probably well integrated with the local community in the study area. In summation then, most migration was by short-range movement from other, declining coal-producing areas, with intermittent long-range movements from such places as Devon and Cornwall and a numerically significant prolonged intake from Ireland and Scotland.

Non-mining Communities

This period is dominated by the advent of coalmining in the four parishes and little is known about the rural and other workers. Agriculture declined, many farmers had migrated to Northumberland earlier, at the end of the eighteenth century (House, 1959). Castle Eden still remained agricultural, although there were more attempts to introduce light industry.

Mining brought railways, both private and public ones. By the end of the period all the villages of the study area were connected to a railway-line which must have improved

communications greatly. The Londonderry private line was one of the few colliery railways to provide a passenger service between Seaham and Sunderland from 1855 to 1900 (Mountford, 1971). The port at Seaham never attained the status hoped for by Chapman largely because it had been designed for sailing ships and when steam-ships were introduced the harbour was found wanting. It was in a very exposed position and is still one of the first to close in bad weather (Burgess, 1961). Large-scale industry came to Seaham in the form of iron manufacture, pottery, glass and bottle works in the 1850s and '60s, until then most of the inhabitants were engaged in sea-faring and retail occupations. In 1851, sea-faring was the largest single occupation in the town, 22% of all males were mariners, while the miners only formed 8% of the workforce (Sturgess, 1980). Larger collieries of Dawdon and Vane-Tempest were opened much later in the century and early in the twentieth and now coal employs 40% of the men of Seaham.

CONCLUSION

This chapter is intended as an historical background to the demographical analysis, rather than a chronological account of the area's history. Archaeological and early historical references to population movement are scanty. Where it is supplied, it is of a qualitative rather than quantitative nature.

There is an abundance of material from the industrial period but that is subject to bias and emphasis on the unusual rather than common state of affairs. Moyes's surname comparisons offer some insight into the extent of continuity of occupation in the pre-mining phase. The period 1797-1876 can be clearly divided into two: an agricultural phase characterised by small, scattered villages with farming as the major occupation and from 1831, a mining phase when large, compact colliery towns were superimposed on this pattern. The two occupational groups probably kept fairly separate. Observations on the endogamous nature of mining communities and their occupational immobility might indicate a closed, inbred group but the high geographical mobility of the miners and the diversity of their origin in the study area would make any claims of genetical isolation dubious. But miners as an occupational group might show some differentiation from the agricultural community.

CHAPTER THREE: GENETICS, DEMOGRAPHY AND RELATEDNESS

POPULATION GENETICS

> "Population Genetics .... assumes the existence of mechanisms for heredity and variation and inquires into the ways in which the genetic makeup of the population is altered or held in equilibrium by the multiple influences of selection. migration and breeding structure." (Crow. 1961)

This definition of population genetics is a succinct expression of the aims of a discipline that is largely based on mathematical theory. For an ideal population Hardy and Weinberg independently formulated a mathematical theorem that predicted the equilibrium ratio of genotypes that could be attained in one generation of random mating, and woud remain constant from one generation to the next if certain conditions were met, including the absence of gene flow and panmixia. Genetic differentiation, observed in human and other populations, is the result of the violation of one or more of these conditions. Experimental evidence can be utilised for animal populations in the search for an understanding of evolutionary processes. Obviously this is not possible in human populations. instead assessments of the effects

of each influence on heterogeneity must be made in the form of mathematical models. These models necessarily simplify the real situation in human populations but as knowledge of these processes increases so the models may become more refined.

Migration Models

Many theoretical models have been proposed to measure the effects of migration on the genetical structure of sub-divided populations. Migration is unlikely to be the only operating factor in a given population, genetic drift, mutation and selection will all be interacting with it but it is suggested that microevolutionary forces are usually dominated by migration to such an extent that 'swamping' of the effects of selection and mutation occurs (Jorde in Mielke & Crawford, 1980). Many of the models focus on the combined interaction of drift and migration.

The earliest and simplest model was one proposed by Sewall Wright in 1943 which considered a sub-divided population, each unit of which was panmictic and of the same effective size, Ne (the proportion of the population that actually contributes to the gene pool at any given time). This 'Island model' assumes that migration is equal between each 'island' and drift is balanced by migration. Each unit will approach the same gene frequency when $4NeMe \gtrsim 1$ (Me is the effective migration rate).

As migration increases gene frequency variance decreases. The model has obvious limitations: the assumption that every cluster will exchange an equal number of its genes with every other is invalid; it disregards distance and variable population size. The only real-life context to which it might be applicable is a large archipelago of islands (Cavalli-Sforza & Bodmer, 1971).

Later models all included the distance factor, hence their general name of 'isolation by distance models'. These can be placed into two categories - continuous and discontinuous types. The latter or stepping-stone model was studied by Malecot and Kimura (Jorde, op. cit) and extended by Kimura and Weiss (1964). Clusters of equal size are assumed to exchange an equal number of migrants with their neighbours only. Migration is considered to be isotropic and symmetrical. In the one-dimensional model, which could represent human populations dispersed along a river, coastline or mountain ridge, migrants are exchanged with two neighbours. Correlation between colonies was found to diminish as distance between them increased. When extended to two and three dimensions this rate of decrease was found to increase with higher dimension. The two-dimensional model, an infinite square lattice of colonies, is a closer approximation to the more usual dispersal of human populations across a plain. while a third dimension might represent social rank. In practice, human colonies do not normally conform to either one or two dimensional cases but to one between. Cavalli-Sforza & Bodmer show how to

derive the correct number of dimensions (op.cit.). Again there are many defects in such a model: real populations do not only exchange migrants with their immediate neighbours, and they are not dispersed infinitely.

Wright recognized the distance limitation in his first model and provided another which did incorporate this factor - the neighbourhood model. This assumes that the population is uniformly distributed amd migration is homogeneous. Migration is accounted for by the frequency distribution of distance between the birthplaces of parent and child. Wright assumed this to be normal when in fact he knew it was leptokurtic. Malecot also utilized a continuous model in his work on isolation by distance which has largely replaced that of Wright (Jorde, op.cit). His models assumed uniform distribution along a line, the probability of migration depending only on distance.

All of these models, discrete and continuous are a simplification of real conditions. Human populations are not dispersed regularly but irregularly in clusters of varying sizes; human migration is not constant, isotropic or symmetrical but is variable, dependent on spatial location and asymmetrical. Their main advantage is the production of relatively simple formulae for predicting local genetic variation.

A recent model utilizes the actual parent-offspring or matrimonial distances to analyse the effect of 'neighbourhood knowledge' on such distribution. (Boyce, Kuchemann & Harrison, 1967). The concept developed from the idea that an individual travels a limited distance in a day from his home base and gets to know his immediate locality well, therefore is likely to obtain a mate from within this area. The authors showed that an exponential relationship existed between frequency of marriage and distance: when allowance is made for the number of inhabitants, frequency of marriage with the residents of a village at a particular point from the home base is inversely proportional to that distance to a power, b. When applied to 1861 census data of Charlton-on-Otmoor, the expected skewed curve was found and a good fit achieved with a value of b almost equal to two. One weakness of the model is that only villages within a radius of six miles were looked at as it was considered that the neighbourhood model would only operate within this distance (M. Smith, pers. comm.).

Migration Matrices

Assumptions of constant, equal, isotropic migration can be avoided by the use of actual rates of migration between clusters. Observed rates have been analysed in the form of a matrix by a number of workers. Each matrix is a square matrix, M, of order N

whose elements m(ij) represent the probability that a gene from population i moves into population j. These probabilities are obtained from parent-offspring or husband-wife birthplace data. They have been applied by Cavalli-Sforza (1968) to data from Lecce province, Italy, to examine the combined effects of drift and migration on genetic variance using an angular transformation.

The matrix approach which is followed in this project is that derived by Hiorns et al (1969) who introduced the concept of relatedness of populations in the genealogical sense of shared common ancestry. The model assumes that populations start at a point of complete unrelatedness and become more related through genetic exchange in the form of migration. Drift, which tends to differentiate populations and slow the process of gene flow, is ignored. Matrimonial data from parish registers were recorded to compile a stochastic matrix whose diagonal elements represented endogamous unions while the off-diagonal ones represented spatial exogamy. These same matrices were also utilised to examine movement between social classes.

One problem is how to deal with exchanges between the population group and those outside it, as only those migrants coming into the group can be quantified. This 'outside world' is infinitely large, therefore the effect of emigrants from the study area is considered negligible and the 'outside world' is

usually treated as homogeneous in composition and its qualitative contribution to each population in the system is the same.

Relatedness between groups, the proportion of ancestry which two populations i and j shared, was computed by Hiorns from the following formula:

$$r(ij) = \sum_{s=1}^{n} \min \left[a(is), a(js) \right]$$

This expression not only accounts for reciprocal exchange between i and j but also movement from other populations to both. For instance, consider three populations, A, B and C with ancestor frequencies as follows:

	A	B	C
A	0.5	0.2	0.3
B	0.2	0.8	0.0
C	0.1	0.2	0.7

From the formula, relatedness between A and B is the sum of the minimum values in rows A and B:

$r(AB) = 0.2 + 0.2 + 0.0$

$= 0.4$

As Constable (1980) remarks, heavy migration from a common source might make two populations related more quickly than would be expected from considering exchange between those two populations alone. Also the assumption is made that migration is undifferentiated in its qualitative effects on the two populations. Hiorns et al decided that when the relatedness value attained 0.95 the populations would be said to be homogeneous; the same criterion is followed in this thesis.

The principle advantages of this matrix approach are the use of observed rates and the avoidance of distorting migration to fit an inflexible model. Its main disadvantages are that it is too cumbersome when dealing with a very large number of group sub-divisions and the method "lacks the elegance and generality of other models" (Jorde, 1980 p162).

Homogeneity or Heterogeneity?

A major defect in all these migration models, including the matrix method, is that they assume migrants are a random sample of their original populations, therefore migration is a homogenising force. But present-day observations suggest that more socially mobile individuals are anthropologically different from the less socially mobile (in Kempton, 1971), in which case such selective migration could have the opposite effect of

increasing differentiation. In order to test this hypothesis, Kempton devised a model in which initially homogeneous populations undergo varying amounts of selective migration. The rate of divergence was found to be more rapid when the migration rate was high but the ultimate difference between populations was greater when migration rates were low. Kempton concluded that where it could be proved that migrants were genetically different from their original population "selective migration ... will be by far the major factor causing genetic differences between the classes."

Recent work in the West Indies has produced convincing evidence of yet another situation where selective migration would in fact decrease heterogeneity between groups (Leslie, 1980) to an even greater degree than expected by random migration. On St. Barthelemy, 73% of those married stayed in their natal quarter. those who married exogamously were much more closely related to their natal quarter than those who remained and married endogamously. This would tend to break up groups of related individuals, decrease inbreeding and increase genetical similarity. However, it would be difficult to detect this effect in other populations without equivalent detailed genealogical data.

HISTORICAL DEMOGRAPHY

Essentially, historical demography is the study of population changes through time, but the goal of the historical demographer is much more complex. He is interested in such topics as the growth of urban centres and its attendant effects on rural communities; the causes of changes in fertility and temporal variation in mortality. The overall intention is to find explanations for historical change on a local and national scale. Wrigley (1966) provides an excellent summary of the aims, achievements and drawbacks of the subject. These aims are obviously very different from those of the genetical demographer, however any study of social conditions, for instance of changes in marriage customs, will have implications for the genetical structure of the community. The results of demographic work can provide the anthropologist with valuable information on the opportunities for selection, the subdivision of populations and their changing sizes.

The discipline has also produced a well-developed methodology which can be utilised and adapted by the geneticist. There are two main techniques available for the exploitation of historical demographic data, aggregation and family reconstitution. The latter brings together scattered information about members of a family so that its main demographic characteristics can be fully described. It is a very detailed, time-consuming method which is

unsuitable for studies of mobility where large areas are involved. For these reasons aggregative methods, where the total numbers of events are looked at, are usually employed by the geneticist. These are not as accurate, but are much quicker, use all the available data and enable a larger geographical area to be included. One of the problems in the thesis was to balance the need for breadth of study with the need for time-depth in a limited amount of research time. Aggregation was more advantageous in this respect than reconstitution.

Historical Records

A possible problem with the historical data sources is that the data were collected for quite different purposes from those of the geneticist. Swedlund (Mielke & Crawford, 1980) makes a very good point when he suggests that this is really an advantage as it precludes the presence of a bias in the data. Several types of historical records exist which can give information on changes in population structure and size such as Hearth tax returns, Marriage duty returns, electoral rolls, Civil Registers of births, marriages and deaths, Parish registers of baptisms, marriages and burials (mainly Anglican but some Catholic and nonconformist records exist), and the Enumerators' returns of the Census from 1801 onwards. Unfortunately, not all these records are available to the public and all are of varying quality.

Hearth tax and Marriage duty returns are most useful for the 17th and 18th centuries. and they provide listings of the population, including surnames, but not direct evidence of migration. They have proved to be of value in genetical studies as demonstrated by Lasker (1977) who has developed a technique for estimating the genetic relationship between communities by comparing like surnames, which has subsequently been applied to Kent (Souden and Lasker 1978) and the Scilly Isles (Raspe and Lasker 1980).

The other sources all provide direct evidence of marital movement during the nineteenth century, but they are not all accessible. The Civil registers would provide the most complete data for immigration in the later part of the century but their inspection is not permitted. Also non-conformist records, except for those of the Quakers, are in short supply until the twentieth century. Despite certain defects to be discussed later, the Anglican registers are the most comprehensive of marriage records from the 16th century onwards. Their importance in investigating patterns of marital behaviour through time is unquestionable. On the other hand, the census with its more precise data on birthplace of partners as opposed to 'origin' or 'residence' is perhaps a more accurate estimate of gene flow, but it offers only a glimpse of a population on one night every ten years and even more importantly for this project, these precise details are only recorded from 1851 onwards, ommitting the period immediately

before the expansion of the coalmining industry in the study area.

It was decided that a combination of both records would prove the best compromise; one source might complement the other in gaining an insight into the genetical relatedness of populations.

SOME RECENT HISTORICAL POPULATION STUDIES

Otmoor, Oxfordshire has been the scene of many detailed genetical and demographical surveys. In the first (Kuchemann et al, 1967), family reconstitution of Charlton parish was attempted to examine birth intervals, fertility, age at marriage, marriage distance and the extent of endogamy. Parish exogamy was found to range from 30% to 64% between 1651 and 1965, higher values being found after 1850 when innovations in transport facilitated travelling. Marriage distance computations indicated a constant mean value of 6-8 miles in the earlier period which increased dramatically to over 40 miles in the later period.

Application of Hiorns's matrix approach to Anglican marriage data from Charlton and its seven neighbouring parishes produced the expected result: the number of generations to reach homogeneity decreased after 1850 when the outside world was included as a ninth population. When the outside world was

ommitted from the matrix the time taken to reach 95% relatedness was actually longer in the later period than pre-1850 showing that most of the exogamy in the later period was with the outside world.

In an examination of social class relatedness in Otmoor, (Harrison et al, 1970), social mobility was found to be more effective in bringing together the five classes than exchange by marriage (16 and 20 generations respectively) but combination of the two caused homogenisation to be even faster, nine generations. However, Harrison observes that these are maximal estimates and it is assumed that exchange individuals are a random sample from the class from which they come. While genetic systems such as blood-groups are not taken into account in mate selection, therefore would be likely to be uniformly distributed it is possible that genes for behavioural traits might still show social stratification.

Consideration of social class and marriage patterns together showed differentiation in spatial mobility in the Otmoor rural area (Harrison et al, 1971). Studies in Oxford City showed a similar trend: amounts of endogamy increased from Class I to Class V (Harrison et al, 1974; Kuchemann et al, 1974). A measurement of the underestimation of gene flow that results from using residence in place of birth-place data was undertaken by a survey of the present-day inhabitants of Otmoor. Birth-place

distance was markedly greater than residence distance, confirming that results are minimal estimates of gene flow (Jeffries et al 1976).

Constable's (1980) study of Pocklington, Yorkshire produced remarkably similar results to those of Otmoor, in terms of numbers of generations to homogeneity including the outside world. Both were rural areas with small, fairly constant population sizes over the period considered. Sudden increases in population, as in the four parishes of this project, are likely to cause radical changes in patterns of marriage distance and mobility. Coleman (1976) considered the influence of population size in determining levels of endogamy. From the findings of a recent national survey conducted for non-genetical purposes, he concluded that endogamy increased as population size increased but those who were still migrant in the larger populations moved very much further and the population sizes of birthplaces of migrant partners were positively correlated. In an analysis of the class effect on movement in modern Reading (Coleman, 1981), distinct differences were found, the class of the wife's father and husband being most significant, in that order. The professional and non-manual groups tended to marry later and move further making their birthplace distances much greater than for manual workers.

Table 3.1: MIGRATION MATRIX RESULTS FROM SOME OTHER POPULATION STUDIES

a) Otmoor Parishes, pre-1850 including 'outside world' (Hiorns, 1969)

BHS								
19	CFM							
19	15	O						
20	16	16	M					
23	22	22	21	WS				
21	20	19	20	23	WN			
20	19	19	19	23	19	AAB		
20	20	20	21	23	15	19	B	
23	23	23	23	25	16	22	18	OW

b) Pocklington, Yorks 1798-1844 including 'outside world'. (Constable, 1980)

Pock										
20	Gt.	Givendale								
18	16	Mill								
18	13	15	Kilnwick							
21	14	19	16	Burnby						
22	14	20	17	15	Wil.					
20	12	18	15	14	13	Bp	Wilton			
22	23	23	23	23	23	23	Thorn.			
19	15	17	15	16	18	16	22	Hayton		
20	10	17	14	13	13	10	23	15	Yapham	
17	16	15	15	18	19	17	21	14	16	Aller.
24	18	22	20	16	16	17	25	20	17	22 OW

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CHAPTER FOUR: MATERIALS AND METHODS

ANGLICAN PARISH REGISTERS

Until 1837, registration of births, marriages and deaths was carried out almost exclusively by the Anglican Parish priest and indirectly by the recording of baptisms, marriages and burials. The first registers were kept in the reign of Henry VIII in 1538, but not all of these very early ones have survived the ravages of time; they mostly date from the latter part of the 16th century. At first registration was left to the vagaries of the incumbent and little effort was made to ensure completeness and accuracy. Some attempt was made at standardization, at least in marriage records, by the passing of the Hardwicke Act in 1753, which introduced pre-printed registers with spaces for the origin of marriage partners as well as details of names and date of the ceremony. The 1812 Rose Act brought the registration of baptisms and burials to the same standard and improved that of marriages slightly by numbering the pages of the books so that ommissions could be checked. The passing of the Civil Registration act involved another change in the type of details recorded: the new printed books for marriages required details of occupation, age at marriage, and residence at the time of marriage.

In order to illustrate the major changes in marriage registration summarised above, the following examples were taken from the records of Dalton-le-Dale:

a) Before 1837:

On this day, 18th October, 1831 were married James Dodds, batchelor of this Parish and Margaret Atkinson, Spinster of this Parish. Witnessed by ....etc.

b) After 1837:

Date married	Name	Age	Condition	Profession
February 16th 1848	William Whitfield	26	Br.	Labourer
	Ann Howey	22	Sp.	-

Residence at time of marriage	Fathers name	Profession
P. of Seaham	John Whitfield	Trimmer
Seaham Harbour	James Howey	Labourer

Apart from these national changes, there were also local attempts at improving the quality of registration. Bishop Barrington of Durham sent a letter to all Clergy in his Diocese in 1797 expressing the wish for an "improved form of parochial

register". This edict did not affect marriages to any great degree, but baptisms particularly show much fuller information. The Bishop sent examples of the type of registration he sought:

Name	Birth	Baptism	Child
William Jones	June 28th	June 30th	Ist son of

Parents

William Jones esq., Native of this Parish by his wife Ann Stephens, Native of this Parish.

Name	Birth	Baptism	Child
James Todd	July 12th	August 17th	8th son of

Parents

Joseph Todd, butcher, son of William Todd N. of Tower Hill, London by his wife Grace, daughter of James Dunn, N. of Glasgow, Scotland.

It seems that not all incumbents complied with this edict, or else it was found too difficult to collect all the details as the Durham registers of this period, 1797-1812, vary considerably in the amount of detail present. Of the four parishes in the study area, only Easington and Dalton-le-Dale contain origin of

grandparents. The Seaham registers sometimes give parents' origin, but never that of the grandparents. The vicar of Castle Eden seems to have ignored the request altogether, as the baptisms of this period are in exactly the same form as previously recorded. The importance of this fuller information to geneticists is the possibility of constructing parent-offspring matrices, for up to three generations, which is often thought the most desirable migration distance to obtain. However, the information is only present for a maximum of fourteen years and as only two of the four parishes analysed here fulfilled the requirements, this was not attempted but in a work covering a broader area it would be feasible.

Eversley (1966) describes in detail the methods of testing registers for completeness, acccuracy and representativeness. Under-registration before 1837 might be caused by political upheaval, (for instance, there are long gaps in registration during the Commonwealth period); by a lack of conscientiousness on the part of the incumbent, by laxity of religious observance or by the presence of nonconformity. The first of these possible defects could be quickly dealt with: the marriage registers of the four parishes did not reveal any gaps in registration during the study period. Fortunately, the second and third possibilities, which are notoriously difficult to discover and make allowances for, were most serious in the recording of baptisms and burials; marriage records are thought to be the most

reliable of them all, particularly after the passing of the Hardwicke act (Krause, 1965). The special problems presented by nonconformity in the study area and Civil Registration are both discussed later.

Inaccuracy of contents can also cause problems for the investigator. A serious defect in the marriage entries mentioned by Eversley (Wrigley, 1966) concerns the possible unreliability of the information on origin in the early nineteenth century in connection with the Poor and Settlement laws. Between 1753 and 1837 'parish of origin' was specified, from 1837 onwards this was changed to 'residence at the time of marriage'. It seems that bridegrooms, in particular and often with the full knowledge of the incumbent, pretended to a settlement at the place of marriage because of the risks of declaring his true origin. Researchers have noted the much higher endogamy rates of the later 18th and early 19th centuries as compared to the 17th and early 18th, which an increase in population alone cannot account for. As there was no easy way to find the true origin of such individuals, the data were recorded as written, but their possible inaccuracy was borne in mind when assessing the results. In fact, as will be seen later, the increase in endogamy between the period in question, which also covers the pre-mining phase, and the later industrial period was sufficiently marked as to make these possible errors unimportant.

Nonconformity before 1837

As seen in Chapter 2, Methodist and other dissenting denominations were particularly strong amongst the mining communities of Durham and Northumberland, but problems of registration before 1837 are not as acute as might be expected. Firstly, the requirements of the Hardwicke act ensured that marriages were much less seriously affected by the presence of nonconformity than were baptisms and burials.

> "Even in the late eighteenth century when nonconformist baptisms were common and nonconformist or non-denominational burial grounds had ceased to become a rarity, Anglican marriages were still an overwhelming majority of all marriages." (Wrigley & Schofield, 1981)

The act forbade the solemnization of marriages outside the Anglican church for all except Quakers and Jews, and it seems that of the dissenting denominations only the Catholics defied the act, at least no post-1753 nonconformist marriage register is known to exist (Steel 1968). There may have been a small number of illegal solemnizations as sometimes difficulties were presented for nonconformists such as the refusal of some Anglican priests to marry dissenters, particularly Baptists who might not be baptized before marriage, but these were negligible. For these reasons it is valid to assume that the dissenting sects

were well represented in the Anglican marriage records of the study area.

Although both Quakers and Jews were exempted from the Act, they can be discounted: the former had diminished in numbers to only 0.21% of the population in 1800, and had further declined to 0.07% by 1861 and there is no evidence of a large Quaker movement in Durham; the latter were mainly distributed in the large towns of the south and the lack of a synagogue before 1837 in County Durham is further proof of their absence in any force in the study area. Both kept clear, accurate records of vital events none of which pertain to the study area.

Representation of the Catholic population in these registers appears to be but a small problem because all the evidence indicates a paucity of 'Papists' in the study area. It is thought that the Catholic community in England as a whole declined in numbers significantly to form only 1% of the population by 1700 and despite suggestions that the North was a Catholic stronghold (viz. Northern rebellion etc.) the study area clearly was not. Returns made by the four parishes in 1641 in compliance with a Parliamentary decree that a form of declaration upholding the Protestant religion and opposing all popery had to be signed by all men over 18, show that Dalton-le-Dale and Castle Eden were both 100% protestant while Easington was 98% and Seaham 86% protestant (Moyes, 1969). These

and subsequent recusancy rolls all point to the main clusterings of Catholics immediately around Durham City, Lanchester and Ryton. The nearest moderately sized group to the four parishes was to the south, around Thornley and Kellow where the Catholic gentry exerted much influence. These included the families of the Trollops in Thornley and the Maires of Hardwicke and Hutton Henry.

This geographical distribution remained unaltered until well into the nineteenth century when Irish migrations to the industrial areas increased the number of Catholics dramatically (Tweedy, 1981). Another return, this time made by Anglican Parish Priests in 1767 revealed 2 Catholics in Dalton-le-Dale, 23 in Easington and none in either Seaham or Castle Eden, a paltry number compared to Ryton (457) and Lanchester (284) (Forster, 1962). Of great relevance to the study period, visitations made by the Bishop of Durham in 1814 yielded further proof of the low influence of the Catholic church in the four parishes: the Easington vicar reported one reputed papist - a farmer in Thorpe; the incumbent of Seaham declared emphatically: "There are no Papists at all in my Parish."; Castle Eden was the home of two Catholics, a labourer and his wife; while the vicar of Dalton-le-Dale was adamant that: "There are no Papists in this Parish". Therefore although it is well known that Catholics flouted the Hardwicke act to a greater degree than any other denomination (Steel, 1968) and marriage registers were illegally

kept in Durham before 1837, their presence in the study area was negligible until the Irish immigrations which occurred in force at the time of Civil Registration. No registers could be found for the study area preceding 1837. It can be concluded that the Catholics were so sparse in the study area that their possible ommission from the registers would have had a negligible effect.

In conclusion, there is enough evidence to show that despite a high frequency of dissenters in Durham County generally, either their presence was small in the study area or they complied with the requirements of marriage registration in the Anglican Church, therefore it is valid to assume that the records of this period were representative of the population.

Civil Registration

When civil registration came into force, marriages could be celebrated in any place of worship that had been registered as such, or in a Register Office. For this reason most historical demographers will not consider using any Anglican records alone after this time unless there is strong evidence of a lack of nonconformity in the area and a continuing precedence of the Anglican faith. Even so, the growing popularity of the Register Office as the place of the ceremony makes their use dubious. However, evidence revealed in the published statistics of the

Registrar-General suggests that Anglican marriages were predominant in the study area until the late nineteenth century. Table 4.1 shows the number of marriages performed outside the rites of the Anglican church as a percentage of total marriages celebrated over five year intervals in Easington Registration District.

In these reports the Registrar's breakdown of the population was by registration district each of which was formed in accordance with the Act of 1836 and continue today. Easington District encompassed a much wider area than the four parishes which formed between 58% (1841) and 73% (1871) of the total population of the District. The part of the district outside the four parishes contained four collieries and several villages, so there is no reason to suppose that the density of Protestant groups was any different in the study area from that of the rest of the district and therefore the percentages can be taken to represent the study area.

The table shows that there was an overall increase in the number of marriage ceremonies outside of the Established church but these only reach considerable proportions in the last six years of the study period. Overall less than 14% of marriages will have been ommitted from the analysis. Although the figures for 1837-1840 were not presented for each R.D., it is safe to assume that non-Anglican marriages were zero or very near to zero

Table 4.1 Marriages celebrated outside the Church of England in Easington Registration District 1841-1876

Year	Total no. marriages	Non-Anglican marriages			
		Tot.	R.O.	R.C.	N.C.
1841-1845	712	0%	0%	0%	0%
1846-1850	732	5%	2%	3%	-
1851-1855	862	5·2%	0·2%	5%	-
1856-1860	1031	8%	0·5%	7·5%	-
1861-1865	1066	9·9%	4·8%	4·7%	0·4%
1866-1870	1158	22%	12·5%	7·3%	1·1%
1871-1876	1686	28·9%	17·5%	9·1%	2·4%

Total number of marriages 1841-1876: 7,247

Non-Anglican marriages: 1,005

Proportion of marriages ommitted from the analysis = 13·9%

Key

R.O. Registry Office ceremonies

R.C. Roman Catholic marriages

N.C. Non-Conformist ceremonies

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as for the next five year period, 1841-5. This makes the total discrepancy even smaller.

One striking fact to emerge from these statistics is the paucity of nonconformist marriages, especially in comparison to the high frequency of Catholic ones. It seems the Catholics were much quicker to take advantage of the new law, which is not surprising in the light of their past distrust of the Anglican service. But it is difficult to explain the low numbers of nonconformist ones, especially as the 1851 Census of Religious Worship reported the existence of many Methodist chapels in the area (see Table 4.2). It is likely that most of these Catholic marriages (which form the majority of non-C.of.E ones) occurred outside the four parishes, in the newly registered churches of Thornley and Hutton Henry in the south of the district as the only Catholic churches in the area were founded very late (Easington in 1876, Seaham Harbour in 1870). However, as we have seen, the Irish Catholic community in Seaham Harbour was fairly strong long before the building of the Church and it is probable that many married in the nearest Catholic centre - Sunderland - which lies outside the R.D. and therefore this group may not be represented. Another interesting trend is the increasing popularity of the Register Office form of ceremony which was noted by the Registrar in his 1871 report for England and Wales.

4.2 NON-ANGLICAN CHAPELS IN THE STUDY AREA IN 1851

(From the Census of Religious Worship)

Dalton-Le-Dale Parish

Murton Colliery:	Primitive Methodist, 1850 Congregation: 96, 180, 200 (morn, aft, even)
East Murton:	Wesleyan Methodist, 1846 Congreg: aft 126, even 144
Seaham Harbour:	Primitive Methodist, 1850 Congreg: aft 130, even 213
	Wesleyan Methodist, 1833 Congreg: morn 80, even 200
	Wesleyan Methodist (Dawdon), 1839 Congreg: aft 65, even 98

Easington Parish

South Hetton:	Primitive Methodist, 1850 Congreg: 245, 330, 330
	Wesleyan Methodist, 1836 Congreg: morn 89, even 101
Easington:	Wesleyan Methodist, 1815 Congreg: aft 33
Shotton Colliery:	Primitive Methodist, 1845 Congreg: aft 154, even 165
	Wesleyan Methodist, 1845 Congreg: 130, 200, 300
Haswell:	Primitive Methodist, 1839 Congreg: aft 210, even 260
	Wesleyan Methodist, 1847 Congreg: aft 150, even 100

It is contended that the use of the Anglican registers can be justified after 1837 in this case because the published data and recorded material show a small discrepancy, less than 14%.

THE CENSUS

The need for a Census had been debated as early as 1753, but suspicion of its purposes and the feeling that it obstructed individual liberty forced its rejection by the House of Lords. By the end of the century attitudes had changed sufficiently for the passing of the Population Act in 1800 which enabled the first census to be undertaken in Great Britain on Monday 10th March, the following year.

The Censuses of 1801-1831 were organized by John Rickman, who was also instrumental in the passing of the Act, and are similar in the range of questions asked and in the manner in which the information was collected. There were two main objectives in the taking of the Census: firstly to ascertain the number of persons, families and houses and to obtain a broad indication of occupations; secondly, to obtain information on the increase of population. These fairly simple aims could be fulfilled in a short, broad questionaire based on the household rather than on the individual. The enumeration was conducted by Overseers of the Poor who filled in schedules requiring numbers of inhabited

houses and persons in the parish, and numbers engaged in agriculture, trade, manufacturing or handicrafts; and by the clergy who supplied numbers of births, marriages and deaths for the previous fifty years. The narrow range of questions asked and the lack of depth of detail make these schedules of limited value to the investigator.

The 1841 and subsequent censuses were organized on a completely different basis and a wider range of information was asked, making these the most useful sources for investigation. The administration was in the charge of G. Lister, the first Registrar General, who divided the 624 registration districts formed in 1836 into subdistricts which were further divided into enumeration districts, each of a manageable size for one person. Being the first, the 1841 census was somewhat experimental and some extensions were made to the questions in the next census, those of 1851, 1861, 1871 remaining essentially the same. Modifications were made in the precision of the birthplace data (only county in 1841, town/parish and county in 1851-1871) and in the addition of relationship to the head of the household. The change in birth-place detail made the 1851 returns preferable to the 1841 ones in this project.

Enumeration of 1851

Full instructions were issued to the enumerators on procedure. In the week before census night, Sunday March 30th, 1851 schedules were delivered to each household, normally by the enumerator but he was permitted to appoint deputies for this purpose, these instructed the householder to fill in the details for all those in his household present on that night. The following day the enumerator collected these schedules, all in one day as far as possible, checked them for completeness and occasionally had to complete them himself on the doorstep. He then copied them into his own enumerators books, making any amendments to obvious errors he thought necessary. By the 8th April he handed both the householders' schedules and his own book to the Registrar who checked both again; they were then sent to the Superintendent Registrar by the 22nd April and finally, the enumerators' books only were sent to the central Census office where clerks checked, made amendments and produced the extracts and tabulations for the printed volumes. It is the enumerators' books that are available to us today; the original householders' schedules have long since been destroyed.

In this way errors could accrue at four different stages: the householder could have given false information, the enumerator might have omitted or duplicated entries in the copying stage (unlikely as later checked) or made false amendments, the

Registrar may have missed obvious mistakes on the part of the enumerator, and the Census checking clerks could have made erroneous corrections especially as he did not have the householders schedules to compare with. Tillot (1972), suggests the checking clerks corrections should be ignored as they were lacking in local knowledge, while those of the enumerator should be trusted as on the whole they were educated, conscientious people who carried out their duties as accurately as they could. In fact the choice of enumerators was guided by the Registrar who suggested that he possess certain qualities:

> "The Enumerator, in order to fulfill his duties properly must be a person of intelligence and activity: he must read and write well, and have some knowledge of arithmetic: he must not be infirm, nor of such weak health as may render him unable to undergo the requisite exertion: he should not be under eighteen years of age, nor older tham sixty-five: he must be temperate, orderly and respectable, and be such a person as is likely to conduct himself with strict propriety, and to deserve the good-will of the inhabitants of his District. He should also be well acquainted with the District in which he will be required to act; and it will be an additional recommendation if his occupations have been in any degree of a similar kind." (Parl. Papers, 1851-3)

Census defects are broadly divisible into errors of coverage and errors in content (Lawton, 1978). Efficient administration ensured that under-enumeration (or possibly over-enumeration) was very small. Comparison of Census material with total numbers of births and deaths in the intercensal years show a small discrepancy which is mainly confined to numbers of infants and small children. Ommission of whole families was highly unlikely. Of the details that are of special importance to the project, the errors in content are probably very small, being subject to clerical error rather than to anything more serious (Tillott, op. cit.) as far as can be judged from the returns themselves. One fairly common error, observed in the data of the study area, is the assignment of some places to the wrong counties because of the use of dittos in the birthplace column, usually this can be corrected with the use of a directory or map. Sometimes the birthplace is not known or cannot be specifically named: one charming entry for Seaham Harbour read simply 'by the sea'! Birthplace statements may be checked by comparing those for an individual in two successive censuses as done by Anderson in Preston (Wrigley, 1972) who found 14% with discrepancies. Whether such inaccuracy was due to clerical error or forgetfulness on the part of the householder, it represented only a small proportion of the whole and was a random error.

It is clear that the enumerators' returns are a very good source for the reconstruction of marital movement in the

mid-nineteenth century onwards.

METHODS OF RECORDING DATA

Register Material

Printed copies of registers, edited by Wood (1910) were used for marriages of Dalton-le-Dale and Seaham from 1797 to 1812, the rest of the data was taken from the original registers kept in County Hall, Durham. All the marriage entries were coded for the computer in the following way:

1. Each entry was given a four digit reference number which was related to its Register number, to enable errrors to be checked.

2. The year was coded as a three digit number for economy of space and effort.
   e.g. 1797 was coded as 797.

3. The month of marriage was coded conventionally, each month numbered from 1 to 12.

4. Next the county, parish and town (if given) were recorded for the husband and wife respectively. Each parish was given a number independent of its county, but the number of a town was dependent on its parish. Thus the unique code for Murton Colliery in the parish of Dalton-le-Dale was 0100102, for Shotton Colliery in Easington Parish 0100402. This system was devised to economise on space and was found easy to manipulate on the computer.

5. The social class and occupational group of groom, groom's father, bride's father, and bride (if given) were recorded next (see below for a full description of designation).

6. The 'civil condition' of marriage partners was coded, indicating single or widowed status.

7. Finally, age at marriage was recorded for the parish of Easington alone. Lack of time prevented the other parishes from being included. In many cases the exact age was not given, only 'of full age', 'above age', or 'under age'. A code was used to indicate whether below or above 21 in these cases.

Coding of Origin or Residence

As already seen, the expansion of the population in this region necessitated the repeated division of parishes into smaller ones, especially from c.1840 onwards. When recording over such a large time span it was clearly impractical to use a different code for each new parish. Consequently, the parish boundaries as defined in 1831 were used throughout the period (see Map 1.2). For instance, although Seaham Harbour budded off from Dalton-le-Dale in 1847 to become a separate parish it was coded as part of Dalton for the whole period. Directories and maps were found to be essential for locating small villages and hamlets (Kelly, 1890; Whellan, 1851)

Designation of social and occupation class

The social class was obtained from the 1966 Registrar's Classification of Occupations. Five broad categories were designated, "homogeneous in relation to the basic criterion of the general standing in the community of the occupations concerned":

1. Class 1: Professional occupations e.g. lawyer, clergyman

2. Class II: Intermediate occupations e.g. farmer, master

mariner

3. Class III: Skilled manual occupations e.g. baker, blacksmith, coal hewer

4. Class IV: Partly skilled manual occupations e.g surface coalminer, agricultural labourer

5. Class V: Unskilled occupations e.g. labourer

This classification was based on three rules:

a) Each occupation was given a basic social class
b) Persons of foreman status whose basic social class was IV or V were allotted to SC III.
c) Persons of manager status were allocated to SC II or III, the latter class applying if basic Class was IV or V.

It was often very difficult to decide upon the social class because the information supplied was so scanty, usually an entry read simply 'coalminer' without indicating above or below ground which can affect the degree of skill involved and therefore the class. Such ambiguous entries were always designated the lowest class possible, with the hope that this consistency would compensate for the resulting inflation of the lower social classes. In accordance with this rule 'coalminer' and 'mariner'

entries were designated Class IV. It is quite probable that the system was not too inaccurate as it is human nature to exaggerate the importance of an occupation rather than the reverse.

It might be suspected that the use of the 1966 Classification would not be applicable to the social structure of the nineteenth century. However Armstrong's analysis (Wrigley, 1972) of such classifications, beginning with the first in 1911 advises against the 1911 attempt because it was a hasty one lacking in refinement and suggests that there was little substantial difference between those of 1921 and 1951. Equally, the differences between the 1951 and 1966 versions were so slight that it was felt that the latters use could be justified. Two other important points in its favour were that it was more easily available, and the results of the analysis could be compared with those of Harrison et al (1970), who applied the same system in Otmoor and Oxford City.

Nevertheless, a social class system is a rigid scheme that might not truly represent the local social structure in a particular region, especially the largely industrial areas of Britain such as the one under study. Another means of division was necessary to supplement social class, that might reflect social stratification more accurately. During a preliminary survey of the registers three major occupational groups appeared to be fairly endogamous: miners, mariners and agricultural

workers (farmers and labourers). Six other groups were defined: a services group (traders, shopkeepers and servants), industrial workers, crafts, professional, labourers and lastly, clerical. This last group was found to be very small so was later amalgamated with the professional group. This system was based purely on the type of occupation engaged in, not on the level within it. Thus farmers and agricultural workers have different social class codes but the same occupation code (occupation 2, Social Classes II and IV respectively). Again, there were difficulties in allocating some occupations and it is emphasised that the classification is not without error. The most important and numerous categories were the first three, therefore the analysis was concentrated on these divisions.

Recording of the Census

The enumerators' returns for the 1851 census for the four parishes are kept on microfilm in County Hall, Durham. As the aim of the exercise was to measure birthplace distances between husbands and wives, only the information for households where both were present was recorded. In some towns this provision meant a loss of some families, for instance many mariners from Seaham Harbour were at sea on Census night; but it is thought that the remaining were representative of the group. The data were coded as follows:

1. The household reference number was recorded so that errors could be checked.

2. The place of residence of the household was recorded as a six digit number, a two digit number for county, parish and town arranged hierarchically - parish being dependent on county, town on parish.
   e.g. The code for Easington village was 010410 (01=Durham Co., 04=Easington P., 10=Easington village).

3. The social class and occupation class were recorded respectively for the householder only as the wife seldom specified an occupation. The same criteria were employed as for the register material.

4. Next the birthplaces of husband and wife were coded in the same way as for place of residence, each consisting of a six figure code. In order to conform with the parish material, the villages were located according to the same 1831 parish boundaries. It was often very difficult to find the places mentioned as variations in spelling existed and there were several instances of towns being attributed to the wrong counties!

5. The exact ages of the couples were recorded.

6. The National Grid references (NGR) of the residence and birthplaces were found in the 1971 Census place-names index (HMSO). An NGR is of the form 'NZ2250', the letters denoting a 100km square. This was converted to a figure, to form a six digit number which located a place within a 1km square. Some workers prefer to use road or rail distances because they might represent the actual distances travelled by individuals more accurately, but the sheer number of different places recorded and the large distances involved made that method impractical. Not all places could be given an NGR, as there was some ambiguity in the required details: parish or town could be given. In those cases where it was not clear whether the town or parish was named, the NGR was ommitted. Intra-town distances were not computed, the distance between couples born in the same town would be zero.

7. Finally, the relationship to parents (son, step-daughter etc.) and birthplaces of all the children in each family were coded, but there was not enough time to analyse this data.

Linked sample

An important part of the project was to determine the extent to which the parish register information on origin, 'residence

before marriage', underestimated gene flow by comparing 'birthplace-distance' and 'residence-distance' of spouses. The marriage register entries of couples resident in the study area in 1851 were found and the details compared. It was a laborious and time consuming task so a complete linkage was not attempted. In fact very few couples could be linked which testifies itself to the high mobility of the poplation. A sample of 82 was felt sufficient. High mobility biased the sample to newly married couples, and a few older ones engaged in rural occupations.

Computer Analysis

The analysis of all data was performed on the Northumbrian Universities Computer (NUMAC) which follows the Michigan Terminal system (MTS). The Michigan Interactive Data Analysis System (MIDAS) was the primary package used for the production of frequencies, tables and distances. The relatedness computation was carried out by a Fortran program, printed in full in Appendix 1. Graphs and maps of frequency distributions were produced by the MIDAS cartographic system, while a Fortran program, combined with the MTS graphical output system (GHOST) produced the point distribution maps.

CHAPTER FIVE: RESULTS

POPULATION TRENDS

Population growth in the study area during the period 1801-1881 (Figure 5.1) emphatically demonstrates the impact of mining: the greatest increase (185%) occurred between 1831 and 1841 when Murton, South Hetton and Haswell collieries were being sunk or opened. Further substantial increases in the next two decades coincided with the winning of Seaham, Seaton and Shotton collieries. Population numbers remained fairly small and constant during agricultural times, but the construction of Seaham Harbour caused the first large rise between 1821 and 1831.

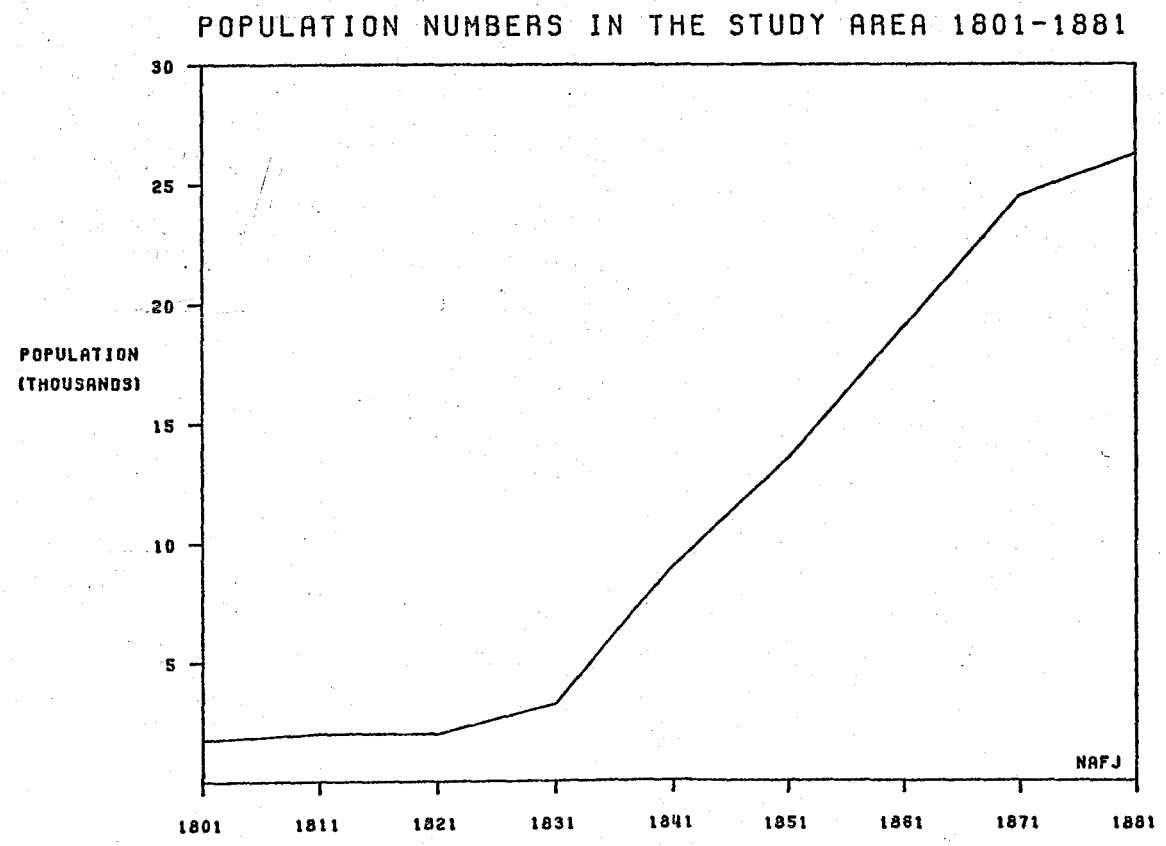

FIGURE 5.1

Inspection of individual parish population trends (Figure 5.2) reveals the outstanding contributions of Dalton-le-Dale and Easington to the over-all population expansion in the area. Rural Castle Eden remained small with low, constant increases in population throughout the period. Seaham experienced mining later than the other two parishes and the rises between 1841 and 1861 are attributed entirely to the settlements around Seaham and Seaton collieries which became the separate parish of New Seaham. (In order to simplify the picture, the splitting of the parishes is not indicated, but all are included in their 'mother' parishes.)

The drop in the population of Easington Parish between 1871 and 1881 may be explained by looking at the growth patterns of individual townships in Table 5.1. The closure of Shotton Grange colliery in 1876 undoubtedly precipitated the decrease of approximately a thousand in the population of Shotton township which accounts for most of the parish decrease. All the agricultural villages show low but steady rises in population and the longstanding importance of Easington village is indicated by its much larger size. The whole parish of Castle Eden is included in one township.

FIGURE 5.2

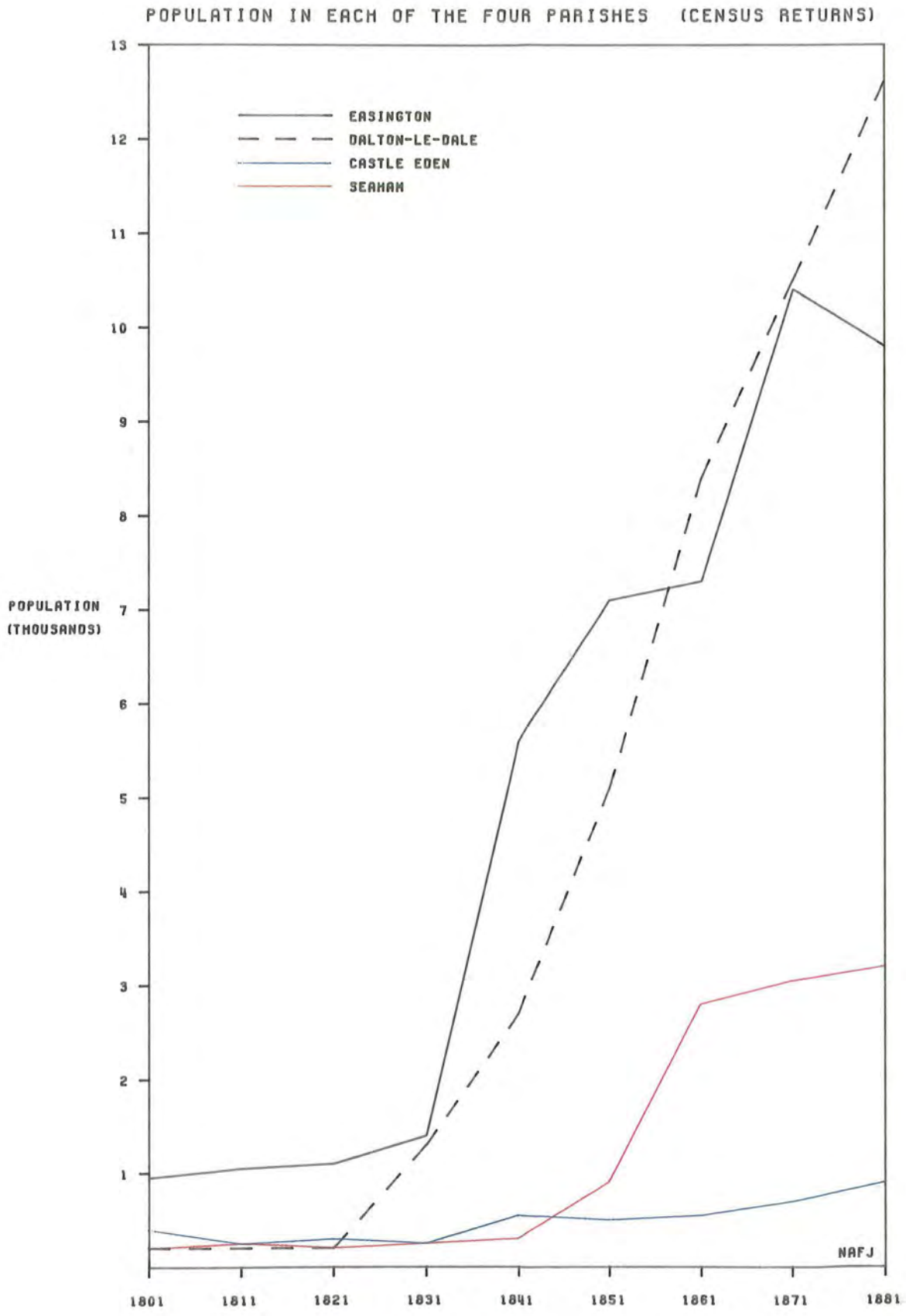
POPULATION IN EACH OF THE FOUR PARISHES (CENSUS RETURNS)
EASINGTON
DALTON-LE-DALE
CASTLE EDEN
SEAHAM
POPULATION (THOUSANDS)
13
12
11
10
9
8
7
6
5
4
3
2
1
1801
1811
1821
1831
1841
1851
1861
1871
1881
NAFJ

Table 5.1 POPULATION: TOWNSHIPS (Census Returns)

	Dalton	C. Heseldon	Murton	Sea. Harb.	C.E. P.
1801	40	48	75	22	362
1811	52	31	71	27	257
1821	49	55	72	35	281
1831	73	112	98	1022	260
1841	88	83	521	2017	558
1851	83	117	1387	3538	491
1861	102	89	2104	6137	535
1871	128	99	3017	7132	693
1881	118	108	4710	7714	880

	Haswell	S. Hetton	Shotton	Hawthorne	Easington
1801	93	-	250	114	487
1811	114	-	286	118	542
1821	115	-	264	140	593
1831	263		272	162	693
1841	3981		603	177	812
1851	4356		1607	183	916
1861	4165		1871	227	1073
1871	3497	2178	3130	268	1428
1881	3861	2295	2131	282	1260

	Seaton/ Slingley	Seaham & NS	Seaham village	New Seaham
1801	96	115	-	-
1811	126	121	-	-
1821	95	103	-	-
1831	134	130	-	-
1841	175	153	-	-
1851	200	729	-	-
1861	236	2591	-	-
1871	228	2802	85	2717
1881	196	2989	138	2851

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PARISH REGISTER ANALYSIS

A total of 4385 marriages were recorded in the four parishes. It was found convenient to divide these into two forty-year periods, 1797-1836 and 1837-1876, which roughly corresponded to the agricultural and mining phases respectively and also coincided with the change in registration details. Changes in numbers of marriages during the study period accord well with the trends in population size. Fig 5.3 shows these figures plotted as nine-year moving averages to smooth out annual fluctuations and clarify trends. The upturn in the graph at about 1827 occurs at the time of the sinking of South Hetton and agrees with the upturn in population numbers. Marriage numbers increase dramatically until 1871 with the exception of a short period in the early 1860s.

In order to test whether the increase in marriages is entirely attributable to greater population size the number of marriages per thousand population was calculated from these moving averages at each censal year (Table 5.2). No clear pattern is visible, but fluctuations in marriage rates exist which are difficult to explain. It might be expected from Haine's work (op. cit.) that higher rates would be found in newly colonised mining towns as the unbalanced sex ratio would initiate early marriage and cause a greater proportion of women to marry at all. High values are found at this time in Easington (a large difference between 1821

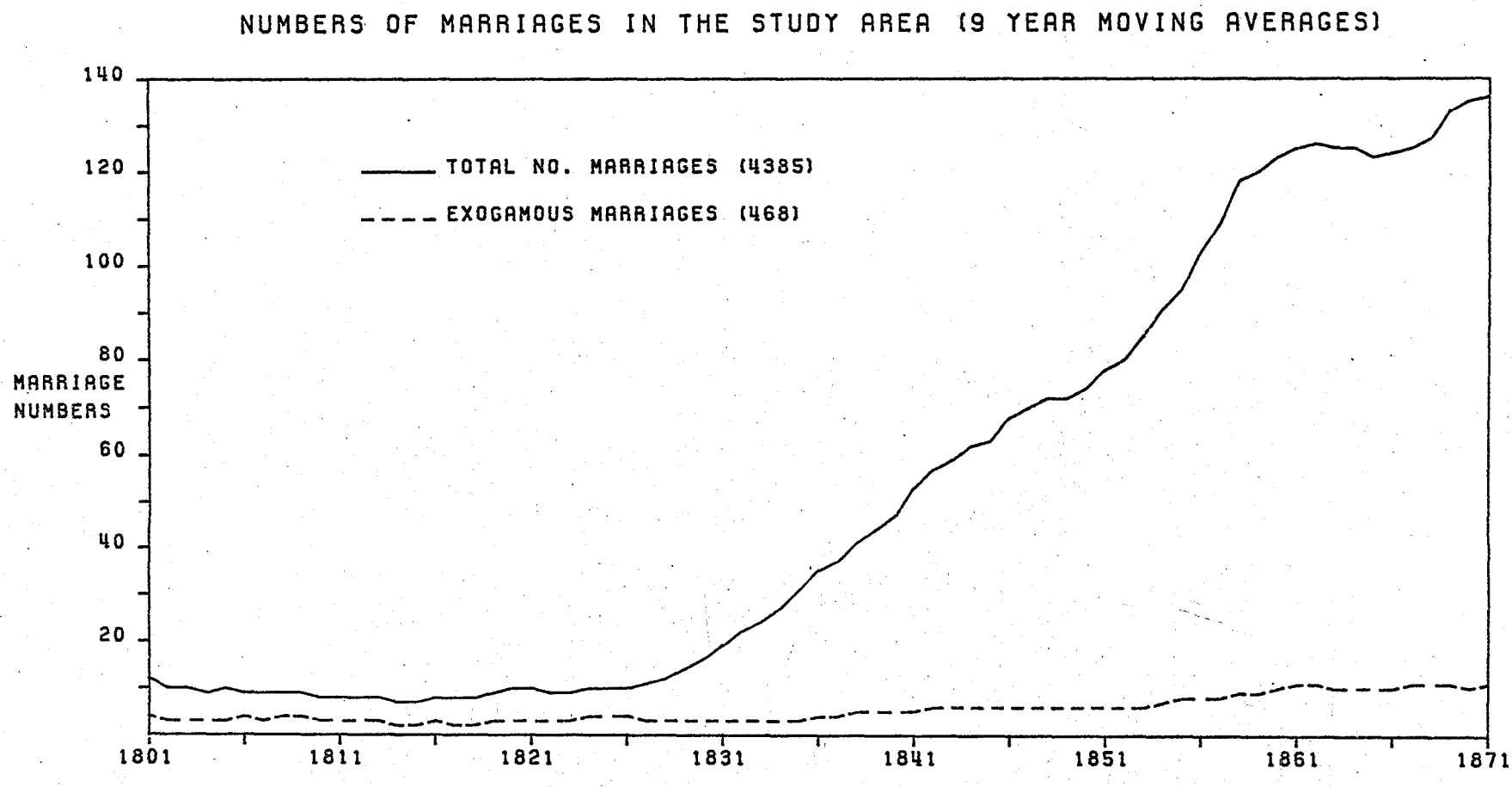
NUMBERS OF MARRIAGES IN THE STUDY AREA (9 YEAR MOVING AVERAGES)
TOTAL NO. MARRIAGES (4385)
EXOGAMOUS MARRIAGES (468)
MARRIAGE NUMBERS
140
120
100
80
60
40
20
1801
1811
1821
1831
1841
1851
1861
1871

FIGURE 5.3

and 1831) and Seaham (1851 and 1861), but there is no definite association between mining and high rates because Castle Eden also exhibits high rates and the highest rate of all is found in Dalton-le-Dale in 1801, before coal mining.

Table 5.2 MARRIAGE RATES

	DleD	SEAHAM	EASINGTON	C.E.	ALL
1801	13.8	8.4	6.2	4.0	6.9
1811	4.9	4.5	4.8	2.6	4.5
1821	5.3	5.1	4.9	6.3	5.2
1831	4.5	3.0	7.1	9.0	5.9
1841	5.7	3.1	5.7	8.2	5.8
1851	5.8	7.9	5.2	5.4	5.6
1861	6.9	8.5	5.3	6.7	6.5
1871	6.1	7.6	4.5	4.2	5.6

These figures can also indicate how representative of the population the registers were. Eversley (Wrigley, 1966) proposed from an analysis of many parish registers that most populations do not produce less than five marriages per thousand population and that any figure less than this that cannot otherwise be explained would suggest registration ommissions. But this figure is based on a minimum baptism rate of 30 per thousand; in places with higher than average fertility, a lower number of marriages

would be possible. 1811 is the only censal year to yield a figure lower than this limit for the study area, which is in part a reflection of the poor preservation of the Castle Eden marriage register between 1794 and 1812: the entries are badly decayed, and those that could not be read were ommitted from the analysis. However all the parishes yielded rates of less than five in 1811 which may perhaps result from the low sex ratio: males only formed 49.9% of the total population in the study area compared to 55.6% in 1831.

Exogamy

Study area exogamy, i.e. marriages where one partner originates from the 'outside world', is also expressed on Figure 5.3. It is notable that their numbers increased only slightly from two to eleven annually throughout the period making the proportion of endogamous marriages increase remarkably during the mining phase and concomitant population growth.

Immigration into separate parishes is expressed as the proportion of 'parish' exogamous marriages to total marriages in each decade in Figures 5.4-5.7. (In this section on the parish material, "migrant" denotes a marriage partner from outside the parish, as the place of marriage is assumed to be the place of settlement after marrriage. This assumption may not be true, but

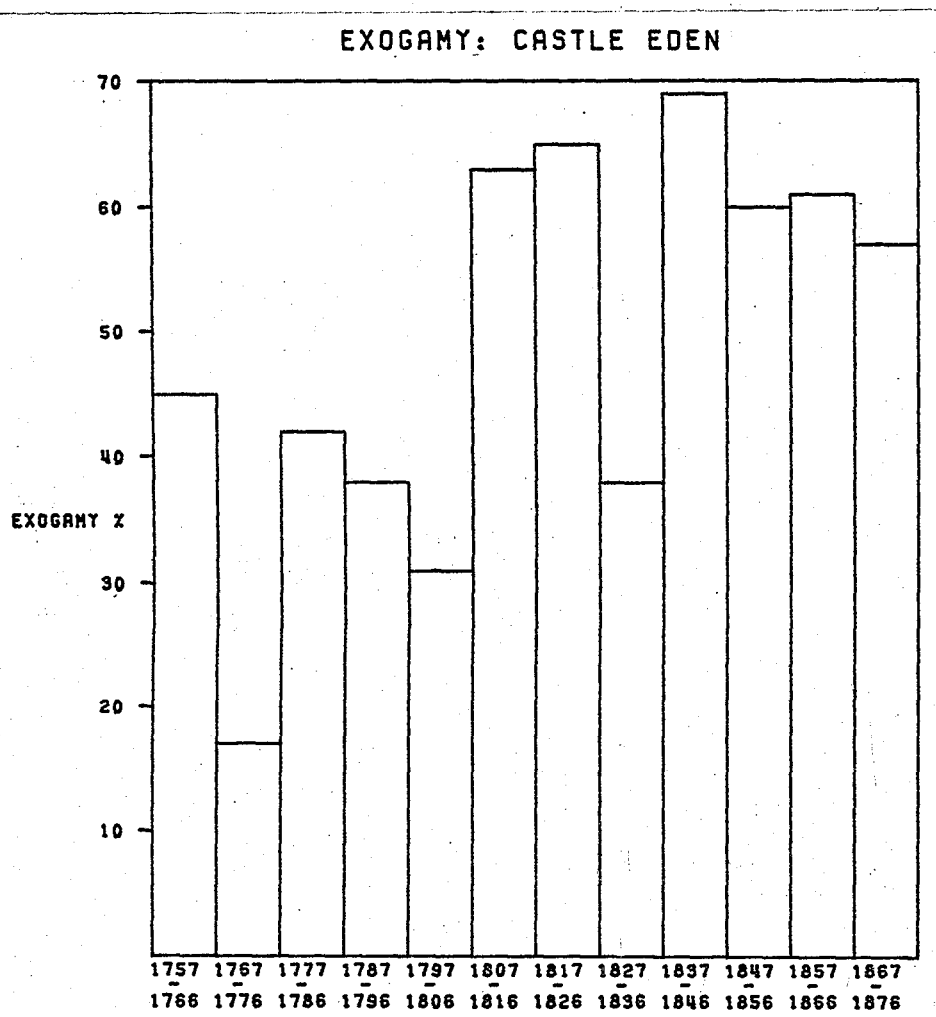

FIGURE 5.4

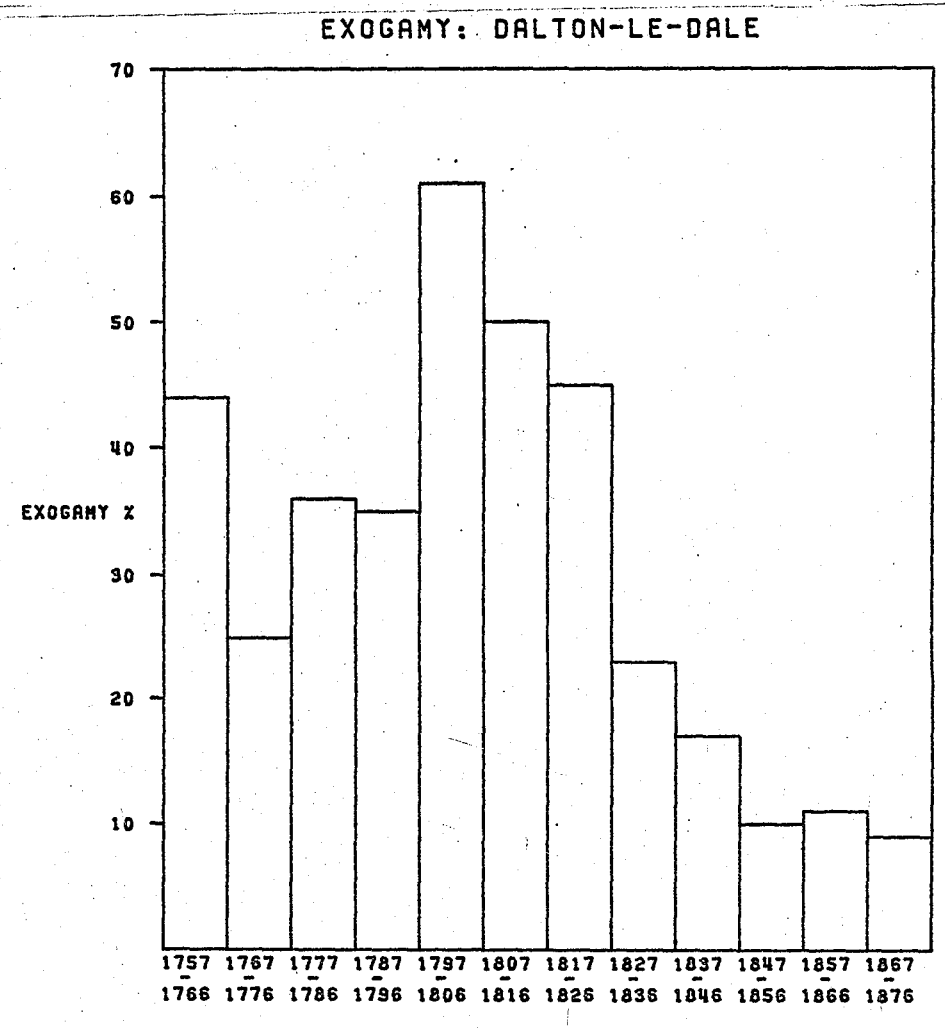

FIGURE 5.5

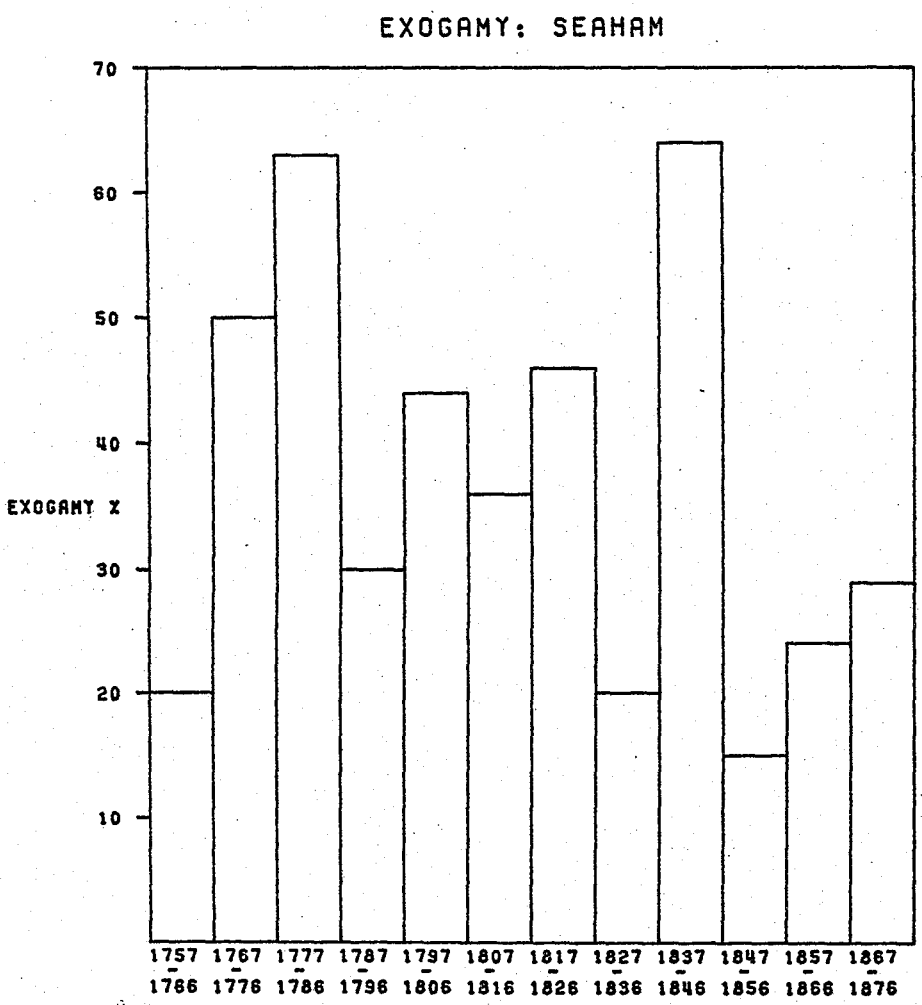

FIGURE 5.6

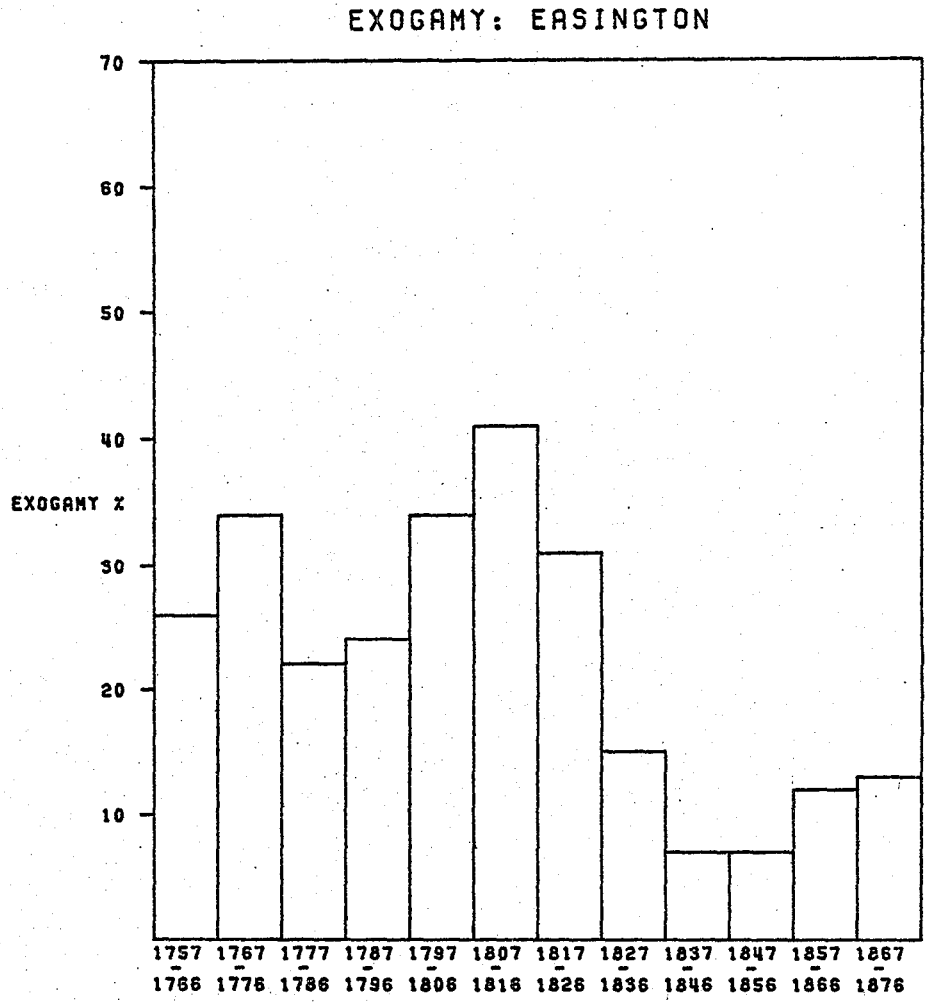

FIGURE 5.7

there is no easy way to check it using aggregative methods.) Marriages between 1757 and 1796 are included in order to examine the effects of population growth better. Exogamy fluctuates wildly in Seaham, reaching its lowest value during the population increase and its highest immediately before. Values for Dalton-le-Dale also fluctuate greatly before 1797-1806 when a peak is reached, followed by a decline which appears to accord well with population growth in the parish. Exogamy in Easington follows a similar pattern. On the other hand the proportion of exogamous marriages in Castle Eden shows a tendency to increase with time. It is likely that increases in endogamy are merely a result of expanding population and a comparison of endogamy and size makes this association clear (Table 5.3).

Size is measured in two ways, by the total number of marriages celebrated in the parish and by the average population calculated from the census figures (1801-1881). Comparison of endogamy with both shows a definite trend for larger size corresponding with a higher rate of endogamy; only Dalton-le-Dale and Easington are out of place but these only differ slightly. Endogamy in the earlier period is lower than in the later period for all except Castle Eden. In the late period endogamy values correspond exactly with size, in the early period only Castle Eden and Seaham are reversed. Patterns of exogamy in Castle Eden are similar to those of Otmoor, Oxfordshire, which was also a small, farming community. It appears that the same forces might apply

Table 5.3 ENDOGAMY AND POPULATION SIZE

a) Whole period 1797-1876

Parish	No. marriages	Endogamous marriages	ratio	Av. popn.
C. E.	187	80	42.8%	480
Seaham	592	437	73.8%	1247
DleD	1794	1593	88.8%	4575
Easington	1812	1588	87.6%	4973
Total	4385	3698	84.3%	-

b) Early Period 1797-1836

Parish	No. marriages	Endogamous marriages	ratio	Av. popn.
C. E.	62	33	53.2%	344
Seaham	52	32	61.5%	250
DleD	106	68	64.2%	918
Easington	269	199	74.0%	2016
Total	489	332	67.9%	-

c) Late Period 1837-1876

Parish	No. marriages	Endogamous marriages	ratio	Av. popn.
C. E.	125	47	37.6%	631
Seaham	540	405	75.0%	2060
DleD	1688	1525	90.3	7858
Easington	1543	1389	90.0%	8050
Total	3896	3366	86.4%	-

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Table 5.4 CALCULATION OF 'REAL ENDOGAMY'

a) Nine year moving averages: total & endogamous marriages

	DleD		SEAHAM		EASINGTON		CE	
1801	2.6	1.0	1.8	1.0	5.9	4.0	1.4	1.0
1811	0.9	0.4	1.1	0.7	5.1	2.9	0.7	0.3
1821	1.1	0.7	1.0	0.6	5.4	3.9	1.8	0.7
1831	5.9	4.6	0.8	0.6	9.9	8.3	2.3	1.4
1841	15.6	14.4	1.0	0.3	31.6	29.4	4.6	2.3
1851	29.8	27.2	7.3	6.2	36.7	35.0	2.7	1.00
1861	58.1	51.4	24.0	18.1	39.1	34.7	3.6	1.4
1871	63.8	58.6	23.0	16.7	46.7	40.4	2.9	1.1

b) Proportion of endogamy per year

	DleD	SEAHAM	EASINGTON	CE
1801	39%	56%	68%	70%
1811	49%	60%	56%	50%
1821	58%	55%	71%	37%
1831	78%	70%	85%	60%
1841	93%	32%	93%	50%
1851	91%	85%	96%	37%
1861	88%	75%	89%	79%
1871	92%	72%	87%	38%

c) Proportions above divided by population size

	DleD	SEAHAM	EASINGTON	CE
1801	0.21	0.27	0.1	0.19
1811	0.27	0.24	0.1	0.19
1821	0.27	0.28	0.1	0.13
1831	0.06	0.21	0.1	0.23
1841	0.03	0.03	0.02	0.09
1851	0.02	0.03	0.01	0.01
1861	0.01	0.03	0.01	0.15
1871	0.01	0.02	0.01	0.05

here - facilitation of travel by mechanised transport causing greater population movement.

Another way of expressing this relationship is to account for population size by calculating a real rate of endogamy. Endogamy percentages at each censal year (number of endogamous marriages divided by total marriages) were divided by population size to produce this figure (Table 5.4). In all parishes there was a decrease in 'real' endogamy from 1801 to 1871. It is now amply clear that population expansion accounts for the inflation in endogamy.

Townships and Endogamy

In the late period the more precise details recorded of place of residence enable us to look at marriage exchange between towns. This is desirable as towns were more likely to be the actual units of migration than parishes. Two towns might be located in two different parishes but so close together that contact between the two would be greater than with towns in their own parishes. However there are still problems in defining such clusters; administrative units need not conform to spatial location and a township might be composed of two very different geographical units: a town and surrounding scattered farmsteads. Despite some drawbacks it was found simplest to use 'township',

an administrative unit, for comparing endogamy and size, and for measuring relatedness. Unfortunately, inclusion of very small hamlets with towns could not be avoided because of their small size, for instance it would have been difficult to have separated Murton village from Murton Colliery as the former would have been so small even though this might have been desirable as the two populations were very different in origin and occupation.

It can be seen from Table 5.5, in which the townships are ordered by size, that there is again a trend for increasing size of township in terms of numbers of marriages celebrated in the town with increasing endogamy. (As marriages were celebrated in the Parish church, in those cases where partners came from different townships in the same parish, the bride's residence was taken as the place of marriage.) There are some notable exceptions. New Seaham is small but has an exceptionally high proportion of endogamous marriages, this might be the result of it being a close-knit mining community; likewise the same reason might apply to Murton Colliery which has a higher level of endogamy than Seaham Harbour but is only half its size. Rural Hawthorne also exhibits a high value for a small place. Lastly, Castle Eden exhibits a much lower level of endogamy compared to places of a similar size such as Easington.

Table 5.5 TOWNSHIPS: ENDOGAMY

Town	No. marriages	Endogamous marriages	ratio
Cold Heseldon	14	6	42.9%
Hawthorne	24	16	66.7%
Dalton	32	10	31.3%
New Seaham	78	55	70.5%
Castle Eden	123	47	38.2%
Easington	125	68	54.4%
Seaham	201	130	64.7%
Seaton	236	174	73.7%
South Hetton	397	343	86.4%
Shotton	461	415	90.0%
Haswell	516	460	89.1%
Murton	550	518	94.2%
Seaham Harbour	1090	960	88.1%
Total	3847	3202	

Note: Total marriages 1837-1876 = 3896
49 cases where information on township is missing

Where partners came from different townships of the same parish, the bride's residence before marriage was taken to represent town of marriage, and therefore part of the figure under 'no. marriages' above.

Origin of Migrants

Where there were study area exogamous marriages most of the migrants, which constituted 5% of all individuals, came from Durham County (82% of grooms, 83% of brides). Northumberland and Yorkshire contributed the next highest number of migrants, 7% and 5% of grooms respectively, 6% and 2% of brides, followed by Scotland, Cumberland, Wales and a much smaller fraction from some southern counties. There were more men from outside the study area than women and these were more widely distributed in terms of numbers of different counties than women (13 and 7 counties, respectively) but this probably reflects the custom of the bride to marry in her own parish rather than differing patterns of movement. Migrants of County Durham were more likely to come from eastern parishes, particularly the neighbouring parishes of Houghton-le-Spring, Bishop Wearmouth, Sunderland and Kelloe but nearly all parishes in the County were represented.

Migration into the study area was higher in the early period than the late period (13% compared to 4%) and the orientation of movement shifted, so that proportions of migrants from counties outside Durham increased in 1837-1876. Tables 5.8 to 5.10 contain numbers of migrants to individual parishes in the two periods, and varying patterns may be discerned. Migrants from Northumberland outweigh those from Yorkshire in the more northerly parishes of Seaham and Dalton-le-Dale while Yorkshire

takes precedence in Castle Eden and Easington. Also Dalton-le-Dale attracted significantly fewer migrants from County Durham than the other parishes (75%, compared to 89% in Easington)

Marriage Exchange and Relatedness

Migration matrices were compiled and relatedness measured following Hiorns's method outlined in Chapter Three. Some were composed for the whole period, others were divided into early and late periods. Residence before marriage was taken to be the place from which partners originated and the place of marriage was assumed to be the place of residence after marriage. These data were tabulated, and converted into exchange matrices by the calculation of row proportions (5.6 to 5.10). As it was assumed that the parishes started at a point of unrelatedness, the ancestor matrix was effectively an identity matrix, which when multiplied by the exchange matrix in the first generation produced a new ancestor matrix with the same values as the exchange matrix. In effect, this matrix was multiplied by itself in each further generation of migration at marriage. The number of generations taken for two places to reach 95% homogeneity are shown in Table 5.11 and these values are expressed spatially on NMMS plots following Kruskal's algorithm (Figures 5.8-5.13).

Table 5.6a Migration Matrix: 1797-1876, Four Parishes only

Place of marriage	Residence before marriage: DleD	Eas	Sea	CE	Total
DleD	3383	31	46	0	3460
Eas	33	3394	6	10	3443
Sea	92	8	1014	1	1115
CE	1	10	1	267	279
					8297

Table 5.6b Migration Matrix: 1797-1836, Four Parishes only

Place of marriage	Residence before marriage: DleD	Eas	Sea	CE	Total
DleD	174	5	4	0	183
Eas	1	468	3	4	476
Sea	2	2	84	0	88
CE	1	4	0	95	100
					847

Table 5.6c Migration Matrix: 1837-1876, Four Parishes only

Place of marriage	Residence before marriage: DleD	Eas	Sea	CE	Total
DleD	3209	26	42	0	3277
Eas	32	2926	3	6	2967
Sea	90	6	930	1	1027
CE	0	6	1	172	179
					7450

Numbers in the matrices represent numbers of individuals either migrating from one parish to another or remaining in the same parish.

Table 5.7 Migration expressed as row proportions

a) 1797-1876 Four Parishes

	DleD	Eas	Sea	CE	Total
DleD	.9777	.0090	.0133	0	1.0
Eas	.0096	.9858	.0017	.0029	1.0
Sea	.0825	.0072	.9094	.0009	1.0
CE	.0036	.0358	.0036	.9570	1.0

b) 1797-1836 Four Parishes

	DleD	Eas	Sea	CE	Total
DleD	.9508	.0273	.0219	0	1.0
Eas	.0021	.9832	.0063	.0084	1.0
Sea	.0227	.0227	.9546	0	1.0
CE	.0100	.0400	0	.9500	1.0

c) 1837-1876 Four Parishes

	DleD	Eas	Sea	CE	Total
DleD	.9793	.0079	.0128	0	1.0
Eas	.0108	.9862	.0010	.0020	1.0
Sea	.0876	.0058	.9056	.0010	1.0
CE	0	.0335	.0056	.9609	1.0

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Table 5.8 MIGRATION MATRIX: Study Area, Outside World and Subdivisions 1797-1876

Residence of individuals before marriage

	DleD	Eas	Sea	CE	Nby	RoD	North	Yorks	RoW	OW' Tot	Tot
DleD	3383	31	46	0	55	40	14	9	9	127	3587
Eas	33	3394	6	10	85	76	4	9	6	180	3623
Sea	92	8	1014	1	34	20	7	1	4	66	1181
CE	1	10	1	267	43	35	6	6	4	94	373
Total										467	8764

Numbers of migrants expressed as proportion of row total

DleD	.9431	.0086	.0128	0	.0153	.0112	.0039	.0025	.0026	.0355	1.0
Eas	.0091	.9368	.0017	.0028	.0235	.0210	.0011	.0025	.0015	.0496	1.0
Sea	.0779	.0068	.8586	.0008	.0288	.0169	.0059	.0008	.0035	.0559	1.0
CE	.0027	.0268	.0027	.7158	.1153	.0938	.0161	.0161	.0107	.2520	1.0
Nby	0	0	0	0	1	0	0	0	0		1.0
RoD	0	0	0	0	0	1	0	0	0		1.0
North	0	0	0	0	0	0	1	0	0		1.0
Yorks	0	0	0	0	0	0	0	1	0		1.0
RoW	0	0	0	0	0	0	0	0	1		1.0
OW	0	0	0	0						1	1.0

Table 5.9 MIGRATION MATRIX: Study Area, Outside World and Subdivisions 1797-1836

Residence of individuals before marriage

	DleD	Eas	Sea	CE	Nby	RoD	North	Yorks	RoW	OWTot	Total
DleD	174	5	4	0	17	9	2	1	0	29	212
Eas	1	468	3	4	24	31	1	4	2	62	538
Sea	2	2	84	0	7	5	1	1	1	15	103
CE	1	4	0	95	10	12	1	0	1	24	124
Total										130	977
Numbers of migrants expressed as a proportion of row total											
DleD	.8202	.0236	.0189	0	.0801	.0425	.0094	.0047	0	.1367	1.0
Eas	.0019	.8699	.0056	.0074	.0446	.0576	.0019	.0074	.0037	.1152	1.0
Sea	.0194	.0194	.8155	0	.0681	.0485	.0097	.0097	.0097	.1457	1.0
CE	.0081	.0323	0	.7661	.0806	.0967	.0081	0	.0081	.1935	1.0
Nby	0	0	0	0	1	0	0	0	0		1.0
RoD	0	0	0	0	0	1	0	0	0		1.0
North	0	0	0	0	0	0	1	0	0		1.0
Yorks	0	0	0	0	0	0	0	1	0		1.0
RoW	0	0	0	0	0	0	0	0	1		1.0
OW	0	0	0	0						0	1.0

Table 5.10 MIGRATION MATRIX: Study Area, Outside World and Subdivisions 1837-1876

Residence of individuals before marriage

	DleD	Eas	Sea	CE	Nby	RoD	North	Yorks	RoW	OWTot	Total
DleD	3209	26	42	0	38	31	12	8	9	98	3375
Eas	32	2926	3	6	61	48	3	5	1	118	3085
Sea	90	6	930	1	27	15	6	0	3	51	1078
CE	0	6	1	172	33	23	5	6	3	70	249
Totals										337	7787

Numbers of migrants expressed as a proportion of row total

DleD	.9508	.0077	.0124	0	.0112	.0092	.0036	.0024	.0027	.0291	1.0
Eas	.0104	.9485	.0010	.0019	.0198	.0155	.0010	.0016	.0003	.0382	1.0
Sea	.0835	.0056	.8627	.0009	.0250	.0139	.0056	0	.0028	.0473	1.0
CE	0	.0241	.0040	.6908	.1325	.0924	.0201	.0241	.0120	.2811	1.0
Nby	0	0	0	0	1	0	0	0	0		1.0
RoD	0	0	0	0	0	1	0	0	0		1.0
North	0	0	0	0	0	0	1	0	0		1.0
Yorks	0	0	0	0	0	0	0	1	0		1.0
RoW	0	0	0	0	0	0	0	0	1		1.0
OW	0	0	0	0						0	1.0

Table 5.11 RELATEDNESS: NUMBER OF GENERATIONS TO HOMOGENEITY

Four Parishes and four parishes with outside world

Dalton-Le-Dale

150	Easington		
29	150	Seaham	
157	65	158	Castle Eden

Dalton-Le-Dale

57	Easington			
33	50	Seaham		
72	58	67	Castle Eden	
74	61	69	21	Outside world

Whole period 1797-1876

Dalton-Le-Dale

86	Easington		
45	89	Seaham	
85	55	89	Castle Eden

Dalton-Le-Dale

20	Easington			
15	20	Seaham		
18	20	17	Castle Eden	
21	24	21	17	Outside world

Early period 1797-1836

Dalton-Le-Dale

155	Easington		
28	156	Seaham	
168	80	168	Castle Eden

Dalton-Le-Dale

64	Easington			
36	57	Seaham		
89	77	83	Castle Eden	
91	80	86	19	Outside world

Late period 1837-1876

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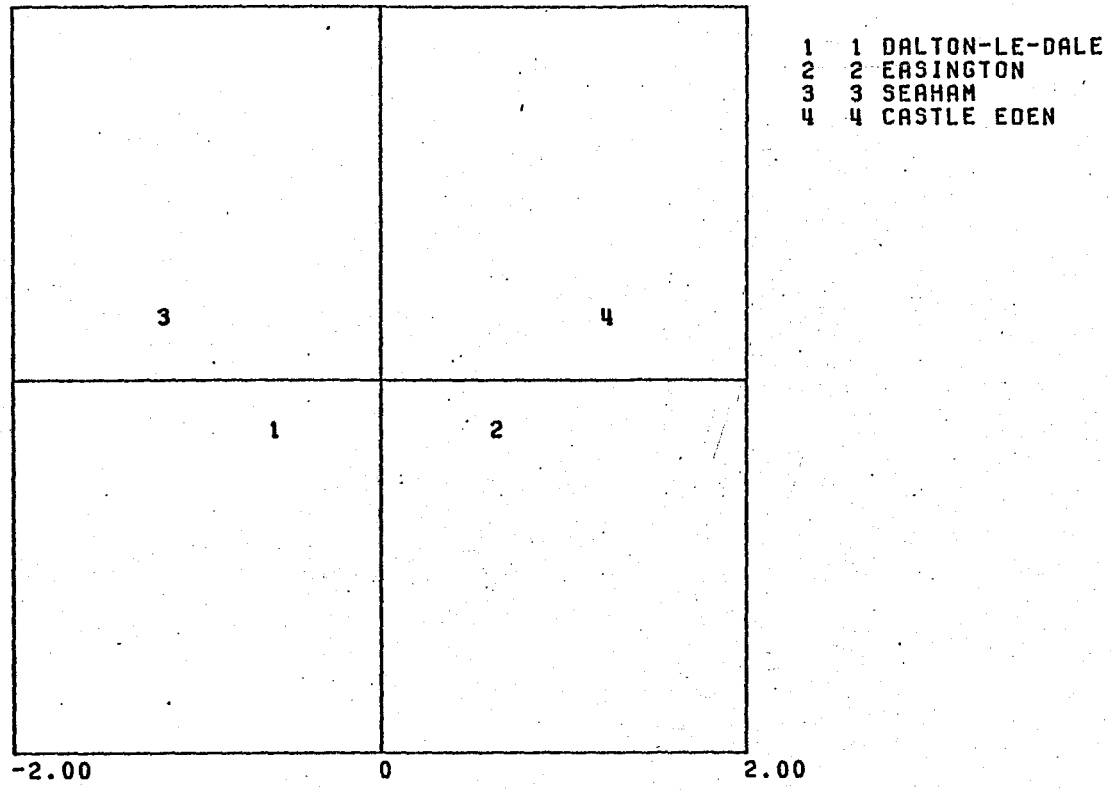


FIGURE 5.8: NMMS PLOT - FOUR PARISHES ONLY

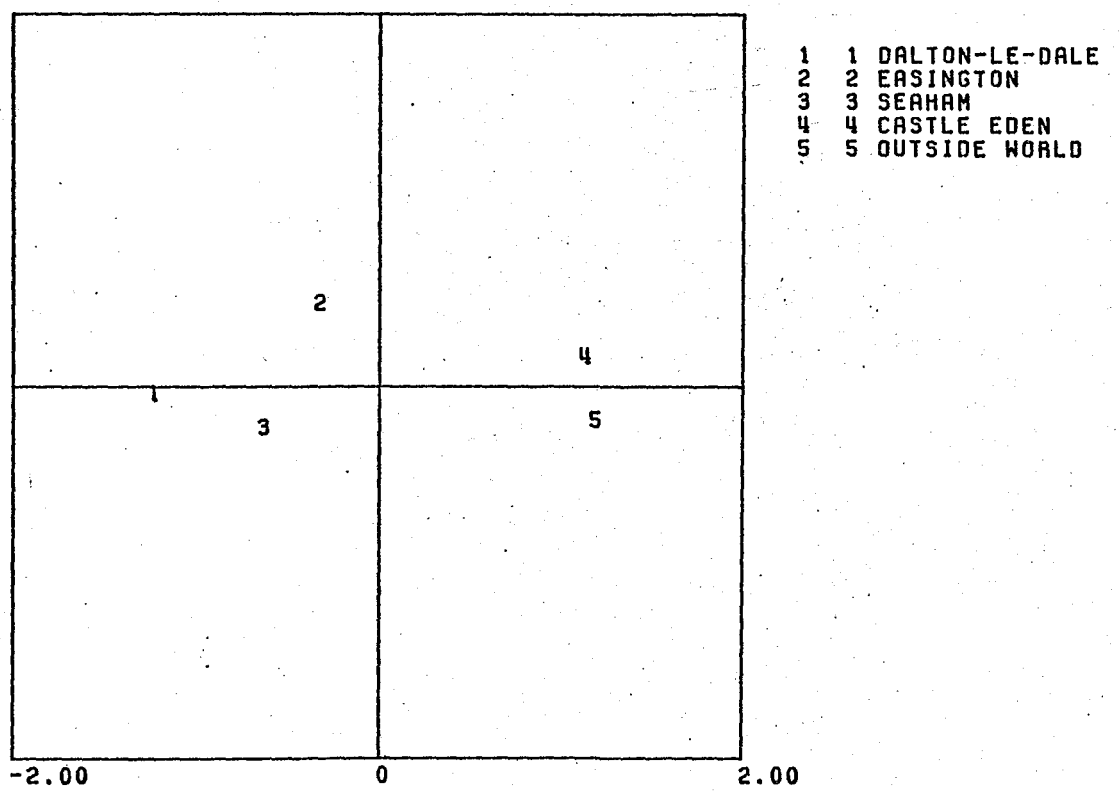


FIGURE 5.9: NMMS PLOT - FOUR PARISHES & OUTSIDE WORLD

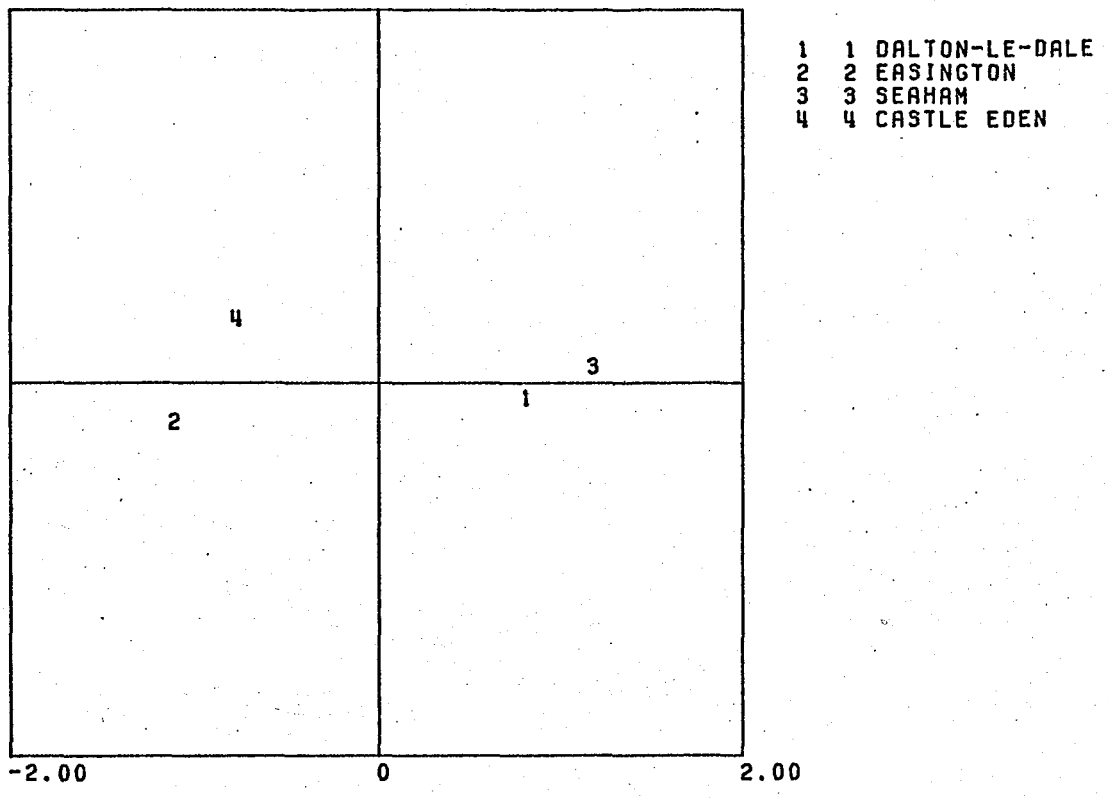


FIGURE 5.10: NMMS PLOT - FOUR PARISHES ONLY
EARLY PERIOD: 1797-1836

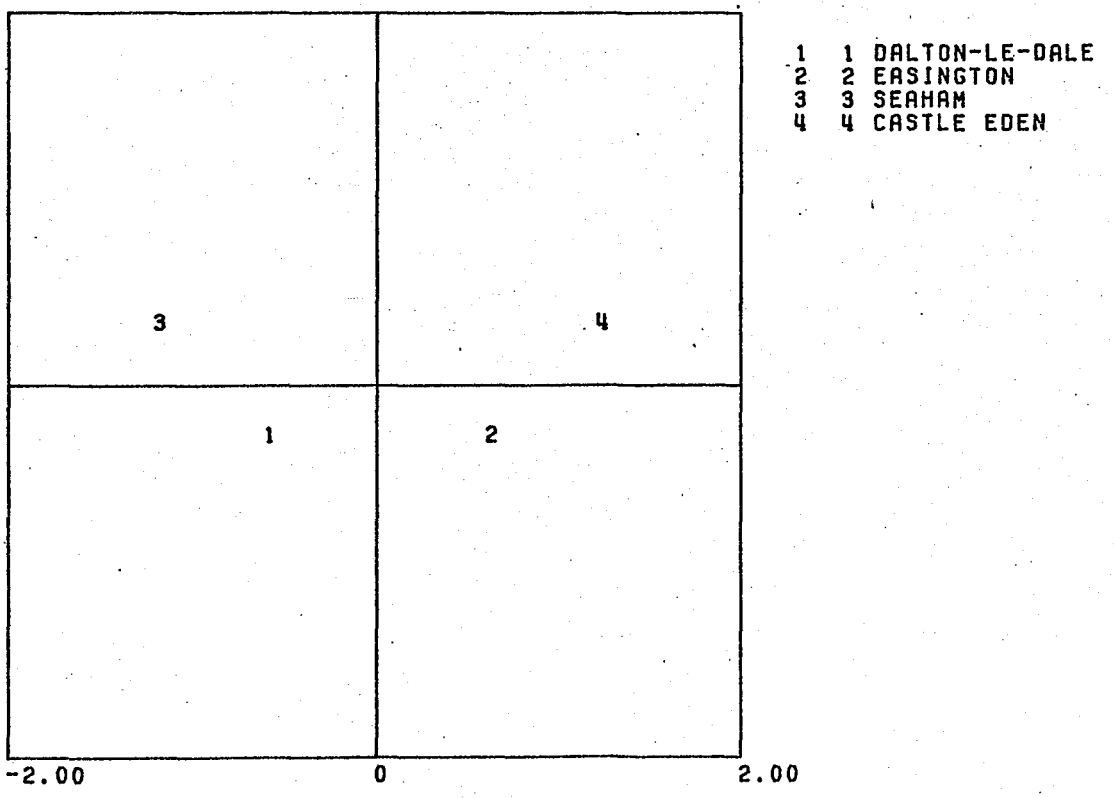


FIGURE 5.11: NMMS PLOT - FOUR PARISHES ONLY
LATE PERIOD: 1837-1876

FIGURE 5.12: FOUR PARISHES & OUTSIDE WORLD
EARLY PERIOD: 1797-1836

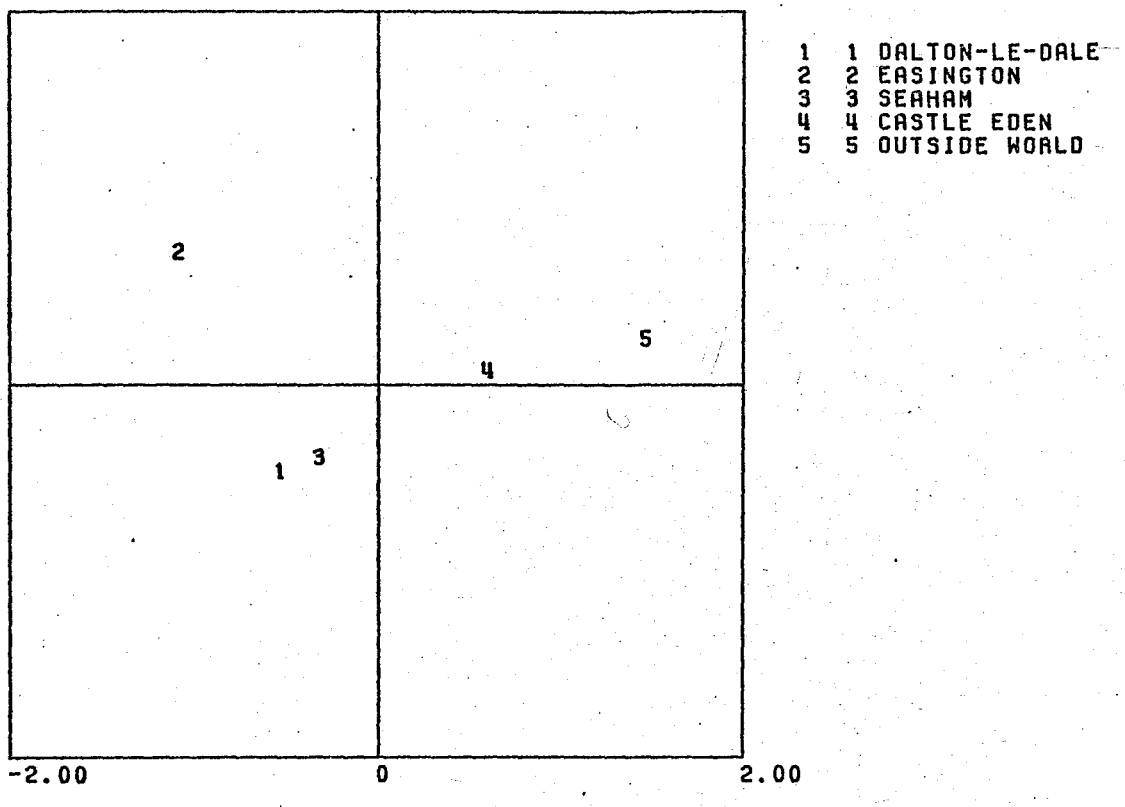
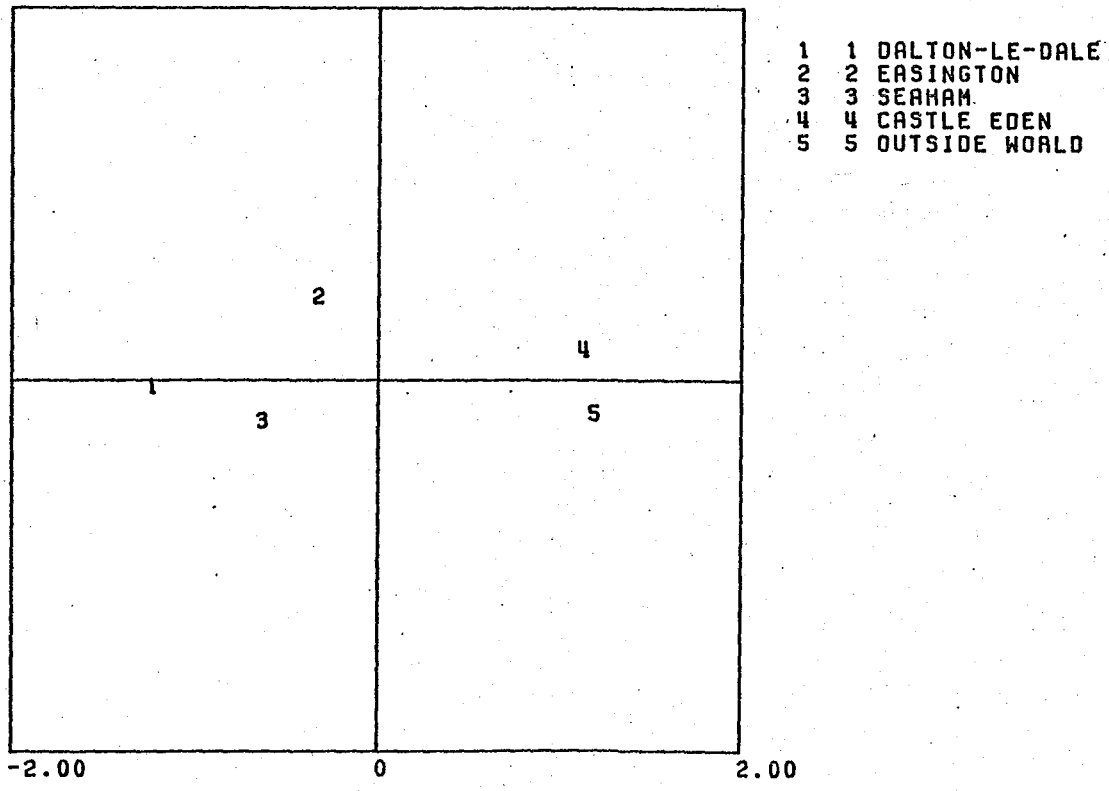


FIGURE 5.13: NMMS PLOT: FOUR PARISHES & OUTSIDE WORLD
LATE PERIOD: 1837-1876



For the period 1797-1836, where migration from the outside world is excluded, the results are compatible with the notion of isolation by distance. Dalton-le-Dale and Seaham become related most quickly and are geographically close together, followed by Easington and Castle Eden; in contrast Castle Eden is furthest from Dalton-le-Dale and Seaham and least closely related to either of them while Easington stands in both senses on middle ground. When 'outside world' migration is included, there is firstly a great decrease in the number of generations for all pairs except Dalton and Seaham and relationships between pairs of parishes are altered a little because of the differing amounts of outside world migrants each parish receives. As expected, Castle Eden became very quickly related to outside world because of its high levels of exogamy and it seems to be fairly separate from the rest of the study area in terms of marriage exchange. The longstanding closeness of Dalton and Seaham is borne out in these results.

When dividing into early and late periods, both when outside world is included and excluded, generation numbers are much lower in 1797-1836 than 1837-1876 and outside world migration tends to accelerate relatedness in both periods. The relationships between parishes are altered slightly when comparing rural and mining periods where outside world is excluded. In both cases though, outstandingly low values are found for the Dalton - Seaham pair and the Easington - Castle Eden pair. The relative

isolation of Castle Eden from the three mining parishes is shown again, as all the mining parishes become related to outside world last while Castle Eden becomes related to it before any other population.

Migration from the outside world has been assumed to be homogeneous. but on observing such migration to individual parishes there is differentiation. Three more matrices were composed incorporating subdivisions of the outside world: 'nearby' (seven parishes bordering the study area: Houghton-le-Spring, Bishop Wearmouth, Sunderland, Pittington, Kelloe, Monk Heseldon and Wingate), rest of Durham, Northumberland, Yorkshire and the rest of the world. Results for the whole period were very unusual; even though the matrices were multiplied for 500 generations only Dalton-le-Dale had become related to Seaham (44 generations) and Easington to Castle Eden (68 generations). Looking at the values for relatedness, they appear to be equilibrating. When dividing into two periods, the same phenomenon is encountered, in the early period, no pairs were related by 500 generations, in the later period only Dalton-le-Dale and Seaham were 95% homogeneous, after 68 generations.

Exchanges between Townships

Exchanges between thirteen townships were analysed in this way (Tables 5.12-5.16) and the NMMS plots provide a clear picture of these relationships (Figures 5.12-5.14). In this case the matrix displays the marriage numbers between towns, which were first converted to numbers of individuals moving between them before the proportions were calculated.

When migration from outside-world is ignored, there is a broad relationship between geographical distance and the number of generations taken to achieve homogeneity for pairs of townships. Two distinct groups emerge: a 'southern' group comprising Castle Eden and Easington parishes, with the exception of Hawthorne, and a 'northern' group. Seaham Harbour, not unexpectedly is more closely related to the towns of Seaham parish than to Dalton-le-Dale and high endogamy in Murton forces its clear distance from neighbouring townships. Hawthorne appears to have much closer links with Dalton and Cold Heseldon villages than its neighbouring rural village of Easington but this is comprehensible because a small dene separates it from Easington and it is geographically much closer to Cold Heseldon than any other village. Migration from the outside world obscures this association with geogaphical distance and some relationships are altered. Notably, Castle Eden stands very close to the outside world and Hawthorne becomes much more closely related to

Easington village. As was seen in the parish analyses, migration from the outside world accelerates the rate of homogenisation.

Another approach to understanding the causes of the patterns of relationships was attempted by plotting distance (as crow flies) against number of generations taken to achieve 95% relatedness for both situations (Figure 5.16). This figure shows the behaviour of the outside world very clearly. Correlation coefficients were significant at the .05% and .01% levels (r=.24, r=.67) and regression analysis produced coefficients of 2.3 and 19.0 respectively which suggest a much weaker association between distance and relatedness when outside world is included. Smith (1981) found the same effect in present-day populations on the Isle of Wight.

The exceptions often prove more interesting than the rule, but in this example they are surprising. The two exceptionally low values of relatedness at a distance of c.7km are the Castle Eden-Haswell and Castle Eden-South Hetton pairs. Migration between these two townships and Castle Eden was minimal, in fact exchanges with Shotton were higher so common migration must be the influential factor. When outside world migration is included, relatedness with these collieries is not achieved as relatively quickly. There are a number of cases which achieve homogeneity much later than would be expected if distance was the only influential factor but these can be explained much more

easily. South Hetton is involved in three of these cases: it lies within 3.5 km of the agricultural villages of Hawthorne, Cold Heseldon and Dalton-le-Dale but takes well over 200 generations to become related to any of them. Clearly here is evidence of negative assortative mating, a barrier between the 'new' mining population of South Hetton and the rural inhabitants.

Summary of Results

Most of these results are confirmation of the effects of high endogamy in the late period. The mining parishes appear to become more isolated, in terms of marriage exchange after 1837 but it must be borne in mind that this high endogamy is the direct consequence of size and the information given in this period states residence before marriage, not birthplace. It is likely that although this method can reveal differentiation in marriage patterns between geographical areas, the genetical consequences are by no means clear-cut. Closer examination of birthplace might suggest much smaller levels of genetical isolation than would appear from the use of this method alone in this particular instance.

Table 5.12 MIGRATION MATRIX: Townships and Outside World 1837-1876

Numbers in the matrix represent numbers of marriages

Residence before marriage

	DleD	Mur	SH	CH	Seah	Seat	NSea	CE	Eas	Haw	Shot	SHet	Has	Tot	OW	Tot
Dled	10	3	7	0	1	0	0	0	0	0	0	0	0	21	11	32
Mur	0	518	6	0	0	2	0	0	0	0	1	6	2	535	15	550
SH	5	17	960	1	19	4	5	0	1	0	1	1	2	1016	74	1090
CH	1	2	2	6	0	0	0	0	0	0	0	0	0	11	3	14
Seah	6	1	26	0	130	16	1	1	0	1	1	0	0	183	18	201
Seat	1	5	15	0	16	174	2	0	0	0	0	1	0	214	22	236
NSea	1	0	11	0	0	0	55	0	0	0	0	0	0	67	11	78
CE	0	0	0	0	0	0	1	47	0	0	2	1	1	52	71	123
Eas	3	1	3	1	0	0	0	3	68	2	7	4	4	96	29	125
Haw	1	0	1	0	0	0	0	0	1	16	0	0	0	19	5	24
Shot	1	1	0	0	0	0	0	1	3	0	415	4	11	436	25	461
SHet	2	6	2	0	0	0	0	0	4	1	3	343	10	371	26	397
Has	0	1	0	0	0	0	1	2	2	0	7	13	460	486	30	516
Tot														3507	340	3847

Table 5.13 MIGRATION MATRIX: migration expressed as a proportion of row total

Townships only 1837-1876

	DleD	Mur	SH	CH	Seah	Seat	NSea	CE	Eas	Haw	Shot	SHet	Has	Tot
DleD	·7381	·0714	·1667	·0238	0	0	0	0	0	0	0	0	0	1.0
Mur	0	·9841	·0056	0	0	·0019		0	0	0	·0009	.0056	·0019	1.0
SH	·0025	·0084	·9724	·0005	·0094	·0020	·0025	0	·0005	0	·0005	·0005	·0010	1.0
CH	·0455	·0909	·0909	·7727	0	0	0	0	0	0	0	0	0	1.0
Seah	·0164	·0027	·0710	0	·8552	·0437	·0027	·0027	0	·0027	·0027	0	0	1.0
Seat	·0023	·0117	·0350	0	·0374	·9065	·0047	0	0	0	0	·0023	0	1.0
NSea	·0075	0	·0821	0	0	0	·9104	0	0	0	0	0	0	1.0
CE	0	0	0	0	0	0	·0096	·9519	0	0	·0192	·0096	·0096	1.0
Eas	·0156	·0052	·0156	·0052	0	0	0	·0156	·8542	·0104	·0365	·0208	·0208	1.0
Haw	·0263	0	·0263	0	0	0	0	0	·0263	·9211	0	0	0	1.0
Shot	·0011	·0011	0	0	0	0	0	·0011	·0034	0	·9759	·0046	·0126	1.0
SHet	·0027	·0081	·0027	0	0	0	0	0	·0054	·0013	·0040	·9623	·0135	1.0
Has	0	·0010	0	0	0	0	·0010	·0021	·0021	0	·0072	·0134	·9733	1.0

Table 5.14 MIGRATION MATRIX: migration expressed as a proportion of row total

Townships and outside world 1837-1876

	DleD	Mur	SH	CH	Seah	Seat	NSea	CE	Eas	Haw	Shot	SHet	Has	OW	Tot
DleD	·6563	·0469	·1094	0	·0156	0	0	0	0	0	0	0	0	·1719	1.0
Mur	0	·9709	·0055	0	0	·0018	0	0	0	0	·0009	·0055	·0018	·0136	1.0
SH	·0023	·0078	·9404	·0005	·0087	·0018	·0023	0	·0005	0	·0005	·0005	·0009	·0339	1.0
CH	·0357	·0714	·0714	·7143	0	0	0	0	0	0	0	0	0	·1071	1.0
Seah	·0155	·0026	·0674	0	·8575	·0415	·0026	·0026	0	·0026	·0026	0	0	·0466	1.0
Seat	·0021	·0110	·0318	0	·0339	·8686	·0042	0	0	0	0	·0021	0	·0466	1.0
NSea	·0064	0	·0705	0	0	0	·8526	0	0	0	0	0	0	·0705	1.0
CE	0	0	0	0	0	0	·0040	·6883	0	0	·0081	·0040	·0040	·2874	1.0
Eas	·0120	·0040	·0120	·0040	0	0	0	·0120	·7720	·0080	·0280	·0160	·0160	·1160	1.0
Haw	·0208	0	·0208	0	0	0	0	0	·0208	·8333	0	0	0	·1042	1.0
Shot	·0011	·0011	0	0	0	0	0	·0011	·0033	0	·9501	·0043	·0119	·0271	1.0
SHet	·0025	·0076	·0025	0	0	0	0	0	·0050	·0013	·0038	·9320	·0126	·0327	1·0
Has	0	·0010	0	0	0	0	·0010	·0019	·0019	0	·0068	·0126	·9457	·0291	1.0
OW	0	0	0	0	0	0	0	0	0	0	0	0	0	1·000	1.0

Table 5.15 RELATEDNESS: GENERATIONS TO HOMOGENEITY

Townships only

DleDale												
157	Murton											
87	180	SH										
71	140	120	CH									
82	172	38	115	Seah								
77	176	44	114	37	Seat							
116	197	56	139	67	72	NSea						
267	233	275	260	272	274	281	CE					
241	195	252	233	248	250	259	142	Eas				
115	143	145	109	134	141	168	250	217	Haw			
291	266	297	286	295	296	302	156	213	278	Shot		
249	207	259	242	256	257	266	119	95	228	200	SHet	
281	253	288	276	286	287	294	116	189	267	102	173	Has

NB These results are derived from the data in Table 5.12. When compiling 5.12, in those cases where the bride and groom came from different townships in the same parish, the bride's residence was taken to represent the residence of the couple after marriage.

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Table 5.15b DISTANCES (KM) BETWEEN TOWNSHIPS

DleDale V.											
1.4	Murton										
3.2	4.5	Seaham Harbour									
2.2	2.2	3.6	CH								
2.2	3.3	2.2	4.0	Seaham T.							
1.4	2.0	4.0	3.6	2.2	Seaton						
1.0	2.2	3.0	3.2	1.4	1.0	New Seaham					
10.2	9.5	11.0	8.1	12.0	11.4	11.2	C.E.				
5.1	4.5	6.3	3.0	7.0	6.3	6.1	5.1	Easing			
3.2	2.8	4.5	1.0	5.0	4.5	4.1	7.1	2.0	Haw		
8.1	7.0	9.8	6.3	10.2	9.0	9.1	3.6	3.6	5.4	Shot	
3.6	2.2	6.4	3.2	5.8	4.1	4.5	8.1	3.6	3.0	5.1	SHet
5.8	4.5	8.5	5.0	8.1	6.3	8.1	7.1	4.0	4.5	3.6	2.2 Has

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Table 5.16 RELATEDNESS: GENERATIONS TO HOMOGENEITY

Townships and outside world

DleDale												
125	Murton											
55	119	SH										
46	117	49	CH									
43	124	40	51	Seah								
41	122	37	44	23	Seat							
36	128	62	65	37	42	NSea						
84	138	97	100	88	91	77	CE					
61	131	78	79	67	70	58	68	Eas				
63	134	84	87	71	75	56	50	46	Haw			
80	122	79	77	80	80	82	96	77	86	Shot		
67	120	65	63	66	66	74	97	75	85	62	SHet	
76	123	75	74	76	75	78	94	73	82	53	52	Has
88	139	99	102	91	94	81	14	73	58	98	99	96 OW

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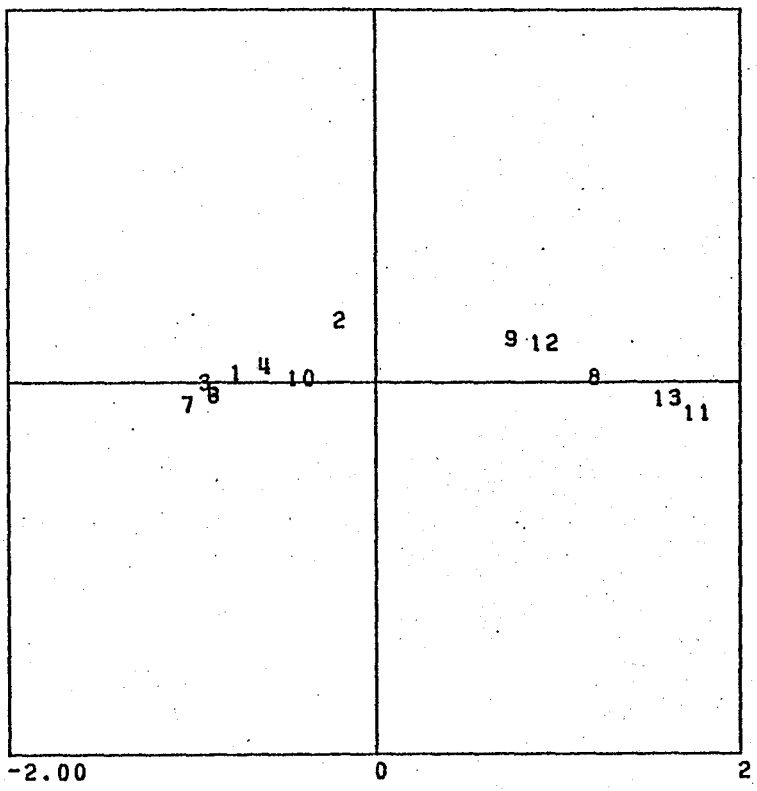
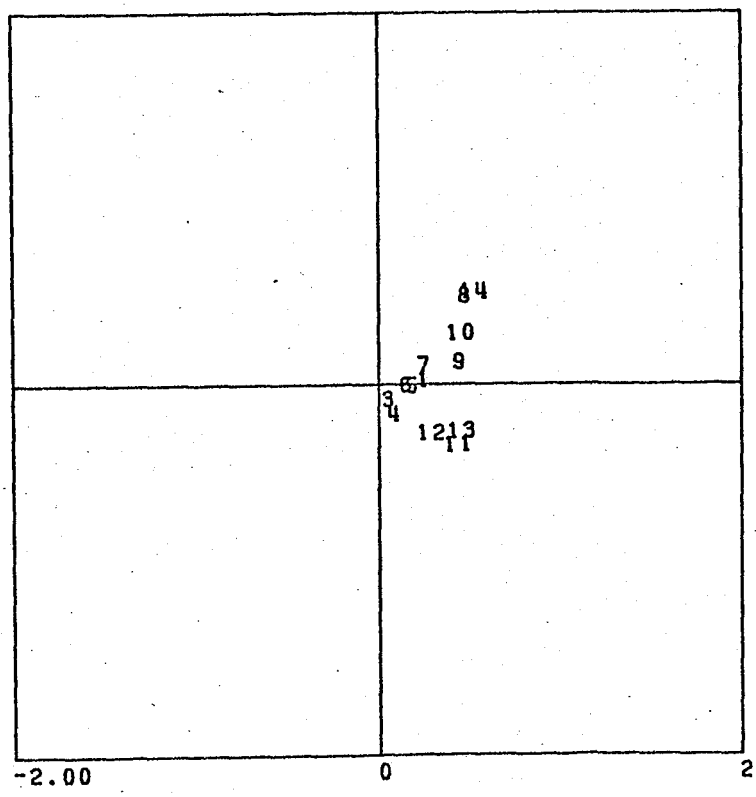
FIGURE 5.14: NMMS PLOT: TOWNSHIPS ONLY 1837-1876



1	1	D-LE-DALE VILL
2	2	MURTON
3	3	SEAHAM HARBOUR
4	4	COLD HESELDON
5	5	SEAHAM
6	6	SEATON/SHARPLEY
7	7	NEW SEAHAM
8	8	CASTLE EDEN
9	9	EASINGTON VILL
10	A	HAWTHORNE
11	B	SHOTTON
12	C	SOUTH HETTON
13	D	HASWELL

FIGURE 5.15: NMMS PLOT: TOWNSHIPS & OUTSIDE WORLD 1837-1876



1	1	D-LE-DALE VILL
2	2	MURTON
3	3	SEAHAM HARBOUR
4	4	COLD HESELDON
5	5	SEAHAM
6	6	SEATON/SHARPLEY
7	7	NEW SEAHAM
8	8	CASTLE EDEN
9	9	EASINGTON VILL
10	A	HAWTHORNE
11	B	SHOTTON
12	C	SOUTH HETTON
13	D	HASWELL
14	E	OUTSIDE WORLD

TOWNSHIPS: RELATION BETWEEN RELATEDNESS AND DISTANCE

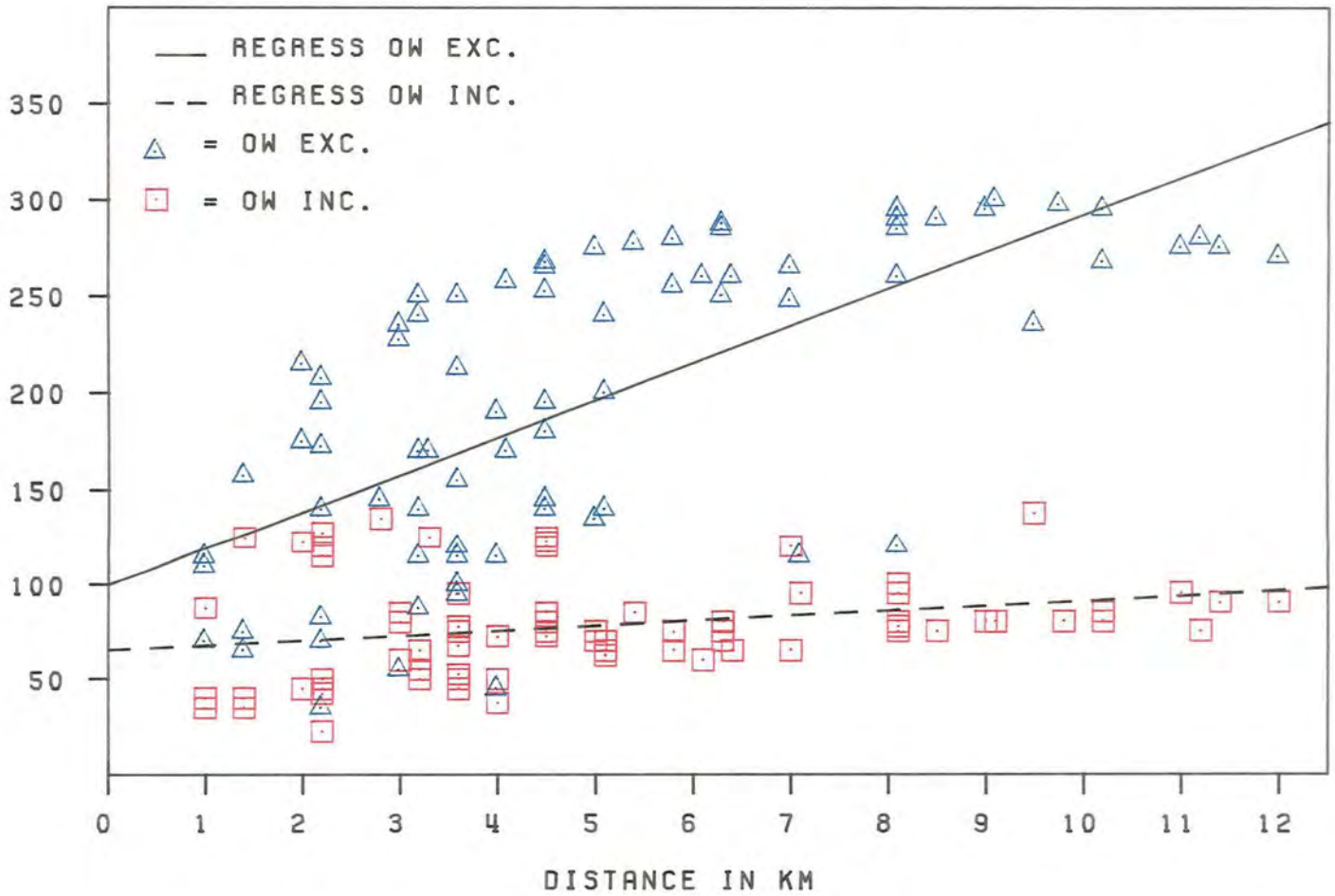


FIGURE 5.16

Occupation and Social Class

From 1837 onwards, the information on occupation enables us to consider the social class composition of the breeding population and the possibilty of occupation or class as barriers to genetic exchange. Usually the groom, his father and the bride's father gave an occupation; brides very rarely had an occupation at the time of marriage in this area. Of the 111 brides (2.8% of all brides) that were employed, most came from Seaham Parish (84, 15.5% of all brides married in Seaham) and Castle Eden (15, 12% of brides in the parish) and they were mainly engaged as domestic servants or school-teachers. The predominantly mining economy of

Table 5.17 OCCUPATION FREQUENCIES IN THE STUDY AREA

Groom's Occ.	Groom's Fa's Occ.	Bride's fa's Occ.
50% miners	41% miners	47% miners
11% mariners	14% labs	12% labs
11% crafts	11% crafts	12% crafts
9% indust	10% agrics	9% mariners
9% labs	8% mariners	8% agrics
4% shopks	6% indust	6% indust
4% agrics	5% shopks	4% shopks
2% prof	2% prof	2% prof

Dalton-le-Dale and Easington parishes would have afforded few opportunities of female employment but it is surprising that not more than three women were employed in Seaham Harbour.

The occupations of grooms, their fathers and bride's fathers may be compared in Table 5.17. As most of the fathers would have spent a large part of their working life before the introduction of coalmining, comparison of the occupations of the two generations is of great interest, but these parents might not have been resident in this area all their working life. As expected, the miners formed the biggest group in all three cases, but were proportionately higher in the younger generation. Seamen were more frequent amongst the grooms than amongst their fathers. There is a notable difference in the number grooms employed in agriculture compared with their fathers and the bride's fathers and many of the older generation simply indicated their occupation as 'labourer' which was probably connected with agriculture. The most difficult group to define was that of 'crafts', as most occupations included in this group were thought to be rural, for example, blacksmithing, cordwaining, but some of these could be performed in the mines which would account for the high proportions seen in both generations.

When dividing the data into two periods of twenty years (1837-1856 and 1857-1876) there is a variation in the frequencies of occupational groups of grooms. There were more miners and

Table 5.18 OCCUPATION COMPOSITION OF THE PARISHES

a) Groom's occupation

Seaham	Dalton-Le-Dale	Easington	Castle Eden
63% miners	36% miners	63% miners	21% crafts
11% crafts	23% mariners	9% crafts	17% agrics
7% labs	12% crafts	9% indust	14% indust
6% agrics	10% labs	7% labs	13% miners
5% indust	9% indust	5% shopks	13% shopks
4% mariners	4% shopks	4% agrics	10% labs
2% shopks	3% prof	2% prof	8% prof
2% prof	2% agrics	1% mariners	3% seamen

b) Groom's father's occupation

Seaham	Dalton-Le-Dale	Easington	Castle Eden
50% miners	30% miners	53% miners	32% agrics
14% crafts	16% labs	13% labs	20% crafts
12% labs	16% crafts	12% crafts	13% labs
10% agrics	15% seamen	9% agrics	9% miners
5% indust	9% agrics	6% indust	8% indust
4% shopks	7% indust	4% shopks	7% prof
3% mariners	5% shopks	2% mariners	6% shopks
2% prof	2% prof	1% prof	4% mariners

c) Bride's father's occupation

Seaham	Dalton-Le-Dale	Easington	Castle Eden
60% miners	34% miners	59% miners	35% agrics
11% crafts	17% mariners	10% crafts	19% crafts
10% agrics	16% labs	10% labs	16% miners
8% labs	14% crafts	9% agrics	10% labs
5% indust	7% indust	5% shopks	9% indust
5% mariners	6% agrics	4% Indust	5% shopks
1% shopks	5% shopks	2% mariners	3% prof
1% prof	2% prof	1% prof	2% mariners

--oOo--

those engaged in the professions in the later period at the expense of the labourers, sailors and agriculturalists. A further breakdown of the data into four decades showed the miners steadily increasing from 47% to 55% of grooms and the mariner group declining from 16% to 8%.

Table 5.18 indicates the variation in occupation composition between the four parishes. The agricultural nature of Castle Eden is confirmed and the importance of Seaham Harbour to the economy of Dalton-le-Dale is borne out by the large number of seamen marrying there.

Relatedness between occupational groups

Contemporary observations have suggested that the miners were largely an occupationally endogamous group i.e. miners tended to marry into other mining families. This was tested by composing exchange matrices for the eight occupation groups. Three sets of matrices were compiled:

1. A matrix of grooms occupation against fathers occupation to measure the extent of occupational mobility.

2. A matrix of groom's occupation versus bride's fathers occupation in order to determine the amount of exchange

between groups through marriage. The bride was assumed to take the occupational group of her father before marriage because she so rarely had an occupation of her own.

3. The two were added together to account for both types of movement after Coleman (1981).

Data and results are shown in Tables 5.19-5.22 and Figures 5.17-5.19. All the data tables show high values on the main diagonal and application of the chi square test indicated that these distributions were statistically significant (groom by groom's father, $X^2=4700$, $p=0$; groom by bride's father, $X^2=2215$, $p=0$) which would suggest that a son's choice of occupation was influenced by his father's to a great extent and that 'assortative mating' for occupation was high. Notably, the highest number of occupationally endogamous marriages were between mining families (76%) compared to the lowest rate of 16% in the industrial group. Size does not seem to be an influential factor as the agricultural group was small but showed the next highest endogamy rate.

Clearly, the most striking result to emerge from the matrix analysis is the comparative isolation of the miners both in terms of marriage exchange and occupational mobility, while those employed on the land also form a distinct group. However the overall numbers of generations necessary to achieve homogeneity

are low, with marriage between individuals of different occupational groups playing the more prominent role in breaking down barriers. The main barrier appears to be between agriculturalists and miners (relatedness between the groups through mobility took the highest number of generations to achieve) which would bear out historical statements on the low occupational mobility of the coal-miners and the paucity of miners from a rural background. On the NMMS plots the mining group is missing because the scale was not large enough to indicate their distance from the other occupations and the solution was obtained using three dimensions to make the relationships clearer. The professional group becomes more quickly related to the others than might be expected but the labouring group is fairly separate.

The combined data produced simply intermediate results in terms of numbers of generations and produced a similar set of relationships between occupations. In this case we are considering the occupation group destination of individuals, women are assumed to be in the same occupational group as their father, then attain the group of their husband at marriage. Men determine their own occupation destination.

Table 5.19 OCCUPATIONAL MOBILITY 1837-1876 ALL PARISHES

	Miners	Seamen	Agrics	Shopks	Indust	Crafts	Profes	Labs	Total Grooms
Miners	1431 (76%)	35	66	41	56	99	10	146	1884
Seamen	7	184 (46%)	41	17	13	74	11	54	401
Agrics	1	0	112 (74%)	2	3	16	2	15	151
Shopkeepers	11	10	35	55 (35%)	7	20	10	10	158
Industry	47	26	26	17	100 (30%)	57	7	48	328
Crafts	28	31	38	20	24	211 (51%)	7	54	413
Professional	10	4	16	9	10	20	17 (18%)	9	95
Labourers	25	10	39	7	12	33	3	201 (61%)	330
Total Gr fas	1560	300	373	168	225	530	70	534	3760

Across: Grooms' fathers' occupation

Down: Groom's occupation

NB Percentages on the major diagonal are percentages of grooms

Table 5.20 MARRIAGE EXCHANGES BETWEEN OCCUPATIONAL GROUPS 1837-1876 ALL PARISHES

	Miners	Seamen	Agrics	Shopks	Indust	Crafts	Profes	Labs	Total Grooms
Miners	1389 (73%)	75	59	28	65	126	7	149	1898
Seamen	55	139 (34%)	28	9	25	63	5	85	409
Agrics	19	5	74 (49%)	7	4	25	4	14	152
Shopkeepers	29	11	32	34 (20%)	8	35	9	8	166
Industry	95	29	28	20	53 (16%)	47	10	41	323
Crafts	98	42	54	31	30	95 (23%)	7	54	411
Professional	13	5	10	16	13	16	18 (18%)	8	99
Labourers	76	19	33	13	24	49	2	110 (34%)	326
Total Br fas	1774	325	318	158	222	456	62	469	3784

Across: Brides' father's occupation

Down: Groom's occupation

NB Percentages on the major diagonal are percentages of grooms

Table 5.21 OCCUPATIONAL MOBILITY & MARRIAGE EXCHANGE COMBINED ALL PARISHES

	Miners	Seamen	Agrics	Shopks	Indust	Crafts	Profes	Labs	Total
Miners	2820	110	125	69	121	225	17	295	3782
Seamen	62	323	69	26	38	137	16	139	810
Agrics	20	5	186	9	7	41	6	29	303
Shopkeepers	40	21	67	89	15	55	19	18	324
Industry	142	55	54	37	153	104	17	89	651
Crafts	126	73	92	51	54	306	14	108	824
Professional	23	9	26	25	23	36	35	17	194
Labourers	101	29	72	20	36	82	5	311	656
Total	3334	625	691	326	447	986	132	1003	7544

Across: Individuals original occupation

Down: Occupation destination for individual

Table 5.22 RELATEDNESS OF OCCUPATIONS: GENERATIONS TO HOMOGENEITY

a) Occupational group mobility

Miners							
10	Seamen						
11	7	Agrics					
10	5	7	Shopkeepers				
9	6	8	6	Industry			
9	4	8	5	4	Crafts		
9	5	8	4	4	4	Professional	
9	6	8	6	5	5	5	Labourers

b) Marriage exchange

Miners							
6	Seamen						
6	4	Agrics					
6	4	3	Shopkeepers				
5	4	5	4	Industry			
5	3	4	3	2	Crafts		
6	4	4	3	4	3	Professional	
5	3	4	4	3	3	4	Labourers

c) Combined data

Miners							
7	Seamen						
8	5	Agrics					
7	4	5	Shopkeepers				
6	5	6	5	Industry			
7	4	5	4	3	Crafts		
7	4	5	3	4	3	Professional	
7	4	6	4	4	3	4	Labourers

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FIGURE 5.17: NMMS PLOT - OCCUPATIONAL MOBILITY
3D SOLUTION

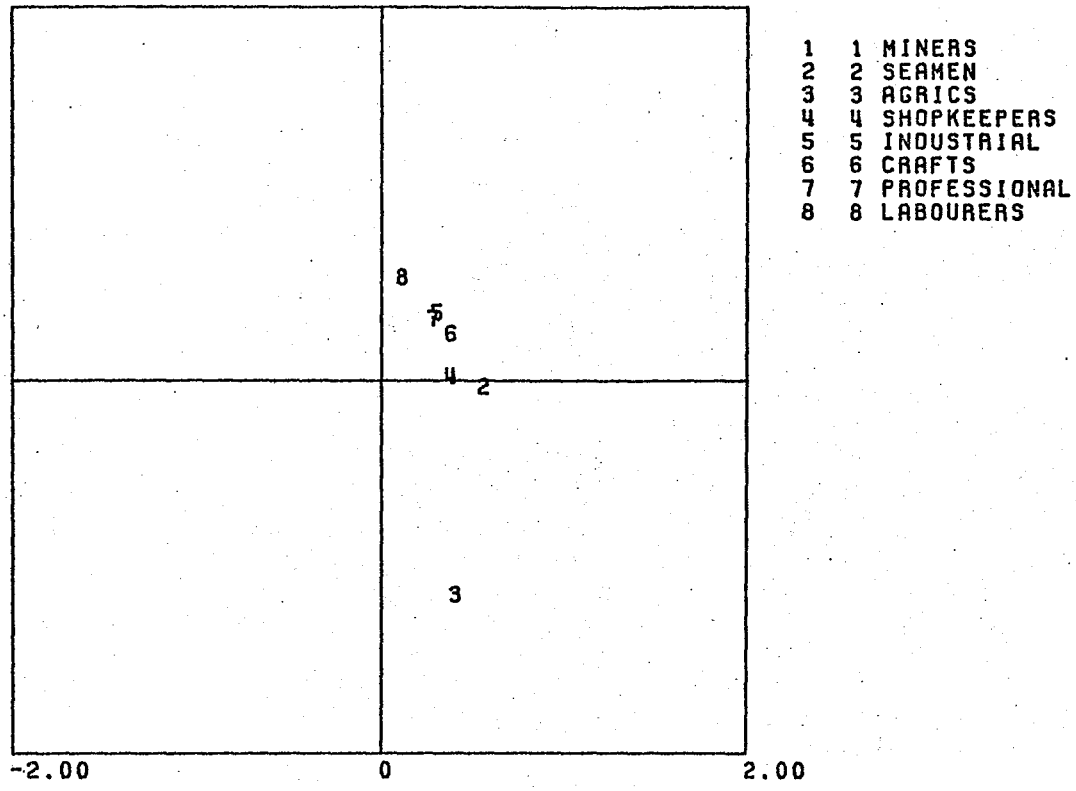


FIGURE 5.18: NMMS PLOT - OCCUPATIONS: MARRIAGE EXCHANGE
3D SOLUTION

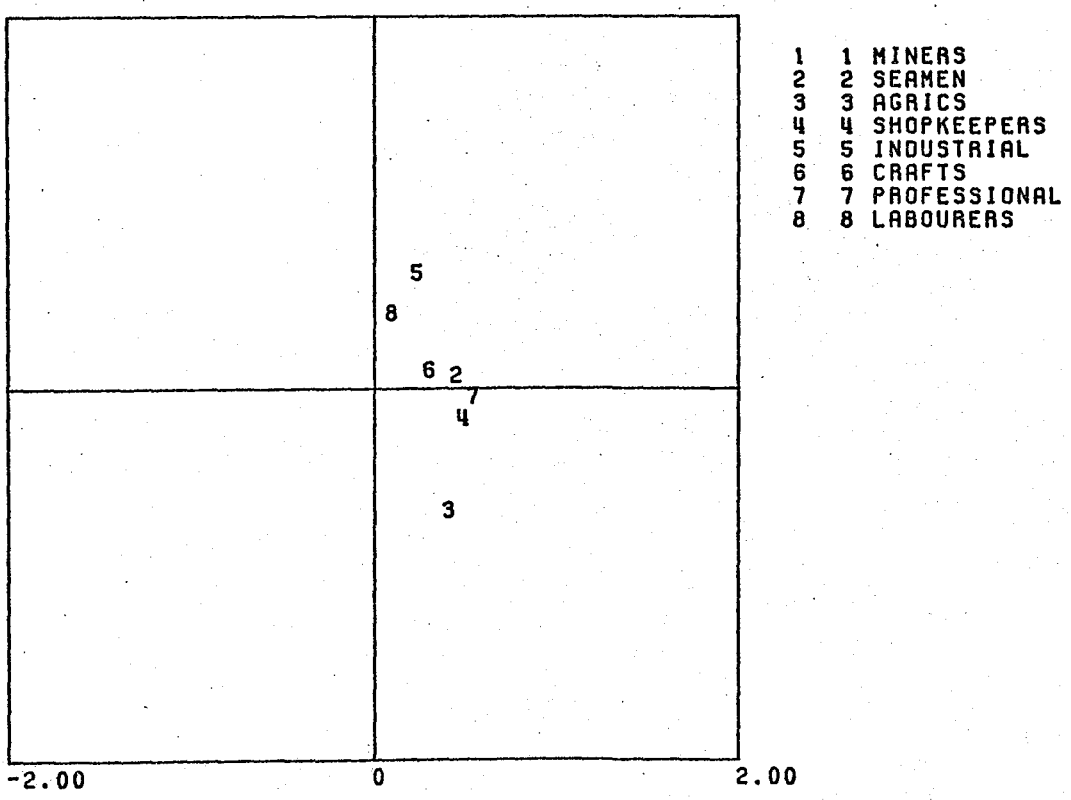


FIGURE 5.19: NMMS PLOT - OCCUPATIONS: COMBINED DATA
3D SOLUTION

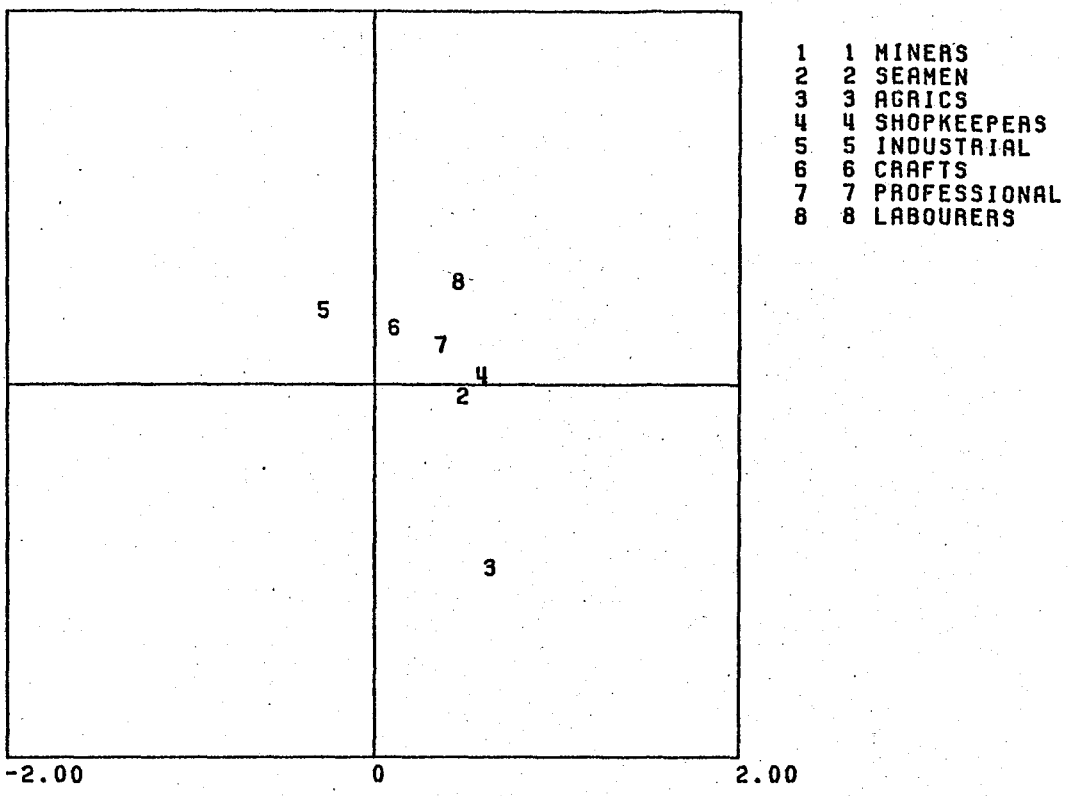
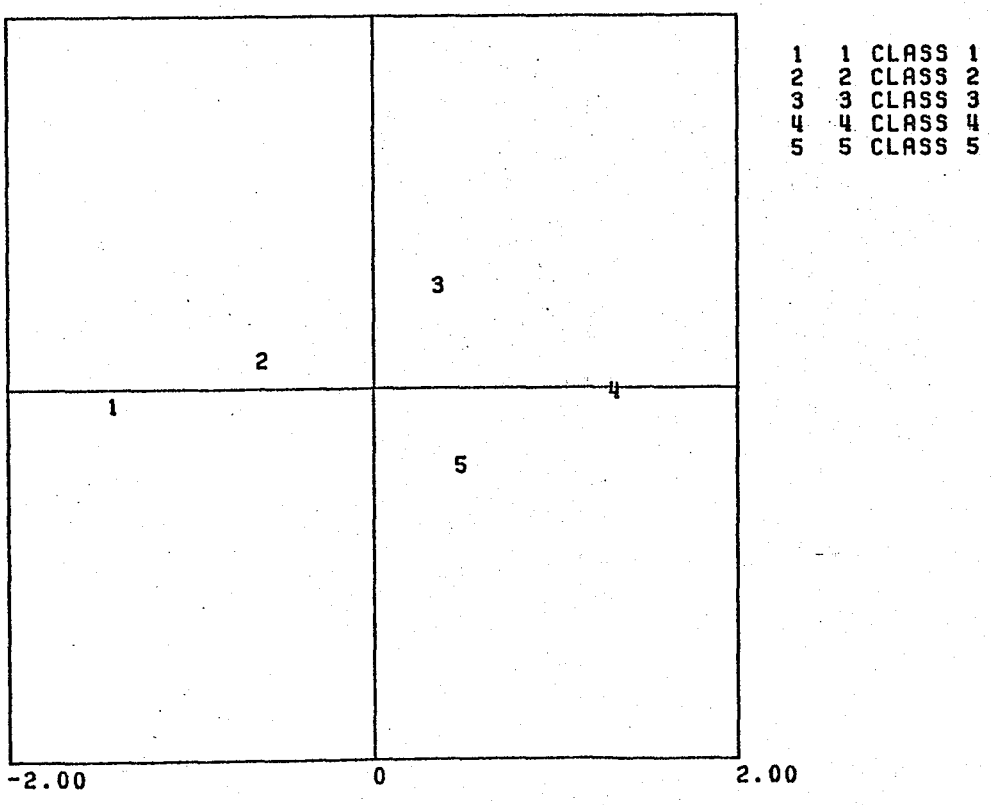


FIGURE 5.20: NMMS PLOT - SOCIAL CLASSES: COMBINED DATA



Social Class

Many difficulties were encountered in classifying individuals into social classes because of the deficiency in detailed information on rank and status. A rough grouping was attempted as described in Chapter Four but because of these problems accurate statements cannot be made. It was also not possible to attribute an accurate social class to those few brides who had employment because their occupations reflected the availability of work to women rather than their social standing in the community; consequently, bride's social class before marriage is determined by her father's.

On the whole the frequencies of the social classes presented in Table 5.23 speak for themselves. Class four was by far the largest group, swollen by the numbers of miners and seamen who described their occupations as simply 'pitman' and 'mariner' respectively. Some of these may have belonged to class III if their work was skilled. The differences in proportions of the various groups between groom and parents can be attributed to the advent of industrialisation, but the higher proportion of Class V amongst groom's and bride's fathers is mainly the result of a higher frequency of the older generation offering only 'labourer' as their occupation. As it is likey that a fair number of these were agricultural labourers who are classified in Social Class IV this higher frequency may not be all that significant.

Table 5.23 SOCIAL CLASS COMPOSITION OF THE PARISHES

a) Groom's Social Class %

Seaham		Dalton-Le-Dale		Easington		Castle Eden	
72	Class 4	59	Class 4	71	Class 4	36	Class 3
15	3	23	3	16	3	34	4
7	5	10	5	7	5	18	2
5	2	7	2	5	2	9	5
1	1	1	1	1	1	3	1

b) Groom's father's Social Class %

Seaham		Dalton-Le-Dale		Easington		Castle Eden	
57	Class 4	47	Class 4	61	Class 4	33	Class 4
22	3	25	3	17	3	27	3
11	5	15	5	13	5	22	2
9	2	12	2	9	2	12	5
1	1	1	1	1	1	6	1

c) Bride's father's Social Class %

Seaham		Dalton-le-Dale		Easington		Castle Eden	
66	Class 4	52	Class 4	64	Class 4	38	Class 4
17	3	22	3	16	3	28	2
8	5	13	2	10	5	19	3
8	2	12	5	10	2	10	5
1	1	1	1	1	1	5	1

d) Social class composition of study area

Groom's SC		Groom's fa's SC		Bride's fa's SC	
65%	Class 4	53%	Class 4	58%	Class 4
20%	3	21%	3	19%	Class 3
8%	5	13%	5	11%	2
6%	2	11%	2	10%	5
1%	1	1%	1	1%	1

--oOo--

Examination of frequencies over time showed Class I proportions fluctuating but remaining much the same, while Classes II and V decreased and Classes III and IV increased slightly. Examination of class composition within parishes shows the expected differentiation between Castle Eden and the three mining parishes, with the former having a higher percentage of Classes I and II in particular.

Exchange matrices were compiled to examine relatedness between classes in the same way as for the occupational groups and the results (Tables 5.25-5.26 and Figures 5.20-5.22) proved to be very different from those of the Otmoor parishes (Harrison, 1970). The absolute numbers of generations cannot be directly compared as the observed data was used here, while Harrison et al modified the data to account for age discrepancies. However, in Otmoor, social mobility caused homogenisation to be attained more quickly than marriage exchange, but in the study area the reverse was true. The patterns of relationships between classes produced by mobility and marriage exchange differ in one notable aspect - Classes I and II are more closely related through mobility than through exchange. Study of the NMMs plots suggest that the major barriers exist between a group formed by Classes I and II on the one hand and Classes III, IV and V on the other when exchange is by mobility but Class I stands alone when exchange is by marriage. On the whole, generations to achieve homogeneity were low; and lower than between occupational groupings but this may

Table 5.25 SOCIAL CLASS MOBILITY ALL PARISHES

Grooms' fathers' social class

Gr SC	I	II	III	IV	V	TOTAL
I	13 (45%)	7	6	2	1	29
II	11	158 (65%)	46	22	5	242
III	6	83	400 (53%)	187	81	757
IV	8	129	310	1759 (72%)	240	2446
V	1	32	46	63	180 (56%)	322
TOTAL	39	409	808	2033	507	3796

Table 5.25b SOCIAL CLASS EXCHANGE BY MARRIAGE

Brides' fathers' class

Gr SC	I	II	III	IV	V	TOTAL
I	11 (38%)	9	8	1	0	29
II	11	112 (46%)	58	52	8	241
III	11	153	259 (34%)	261	71	755
IV	5	123	338	1788 (72%)	223	2477
V	0	33	67	123	98 (31%)	321
TOTAL	38	430	730	2225	400	3823

Table 5.25c SOCIAL CLASS MOBILITY & EXCHANGE COMBINED

Individuals class origin

	I	II	III	IV	V	TOTAL
I	24	16	14	3	1	58
II	22	270	104	74	13	483
III	17	236	659	448	152	1512
IV	13	252	648	3547	463	4923
V	1	65	113	186	278	643
TOTAL	77	839	1538	4258	907	7619

Down: Class destination of individual

Table 5.26 RELATEDNESS: GENERATIONS TO HOMOGENEITY

a) Social Class mobility

Class I			
4	Class II		
7	7	Class III	
8	8	5	Class IV
7	7	4	5 Class V

b) Social class exchange by marriage

Class I			
5	Class II		
6	4	Class III	
6	5	4	Class IV
6	5	3	4 Class V

c) Social class mobility and marriage exchange combined

Class I			
4	Class II		
6	5	Class III	
7	6	5	Class IV
7	6	4	4 Class V

FIGURE 5.21: NMMS PLOT - SOCIAL CLASS MOBILITY

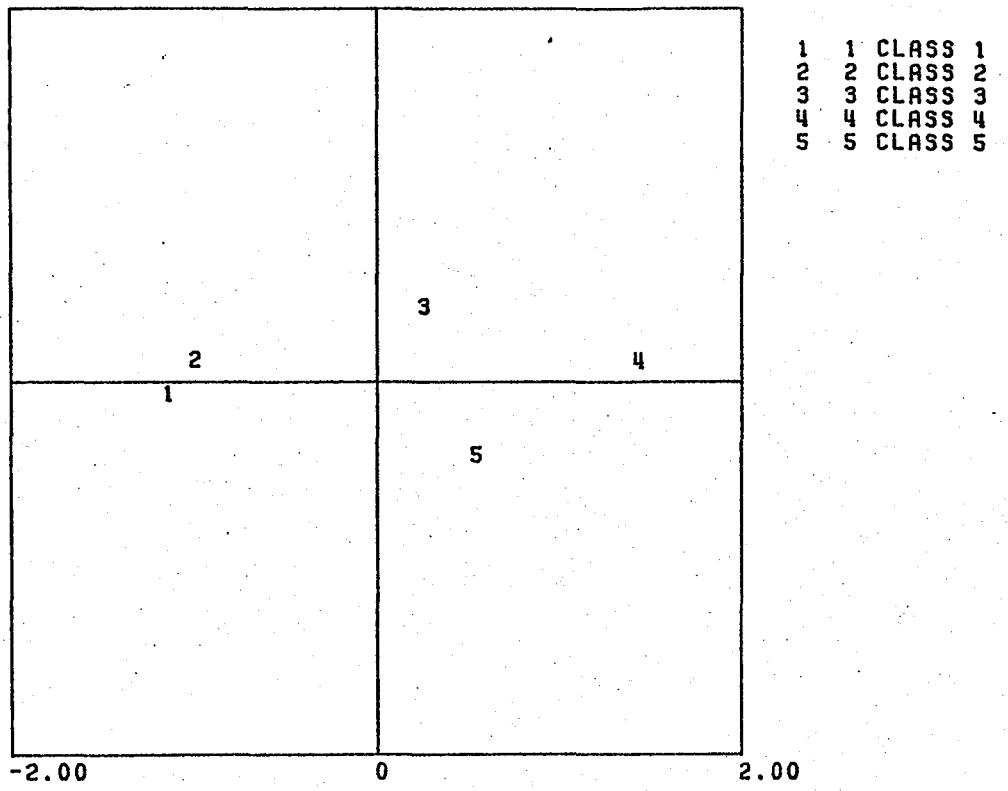
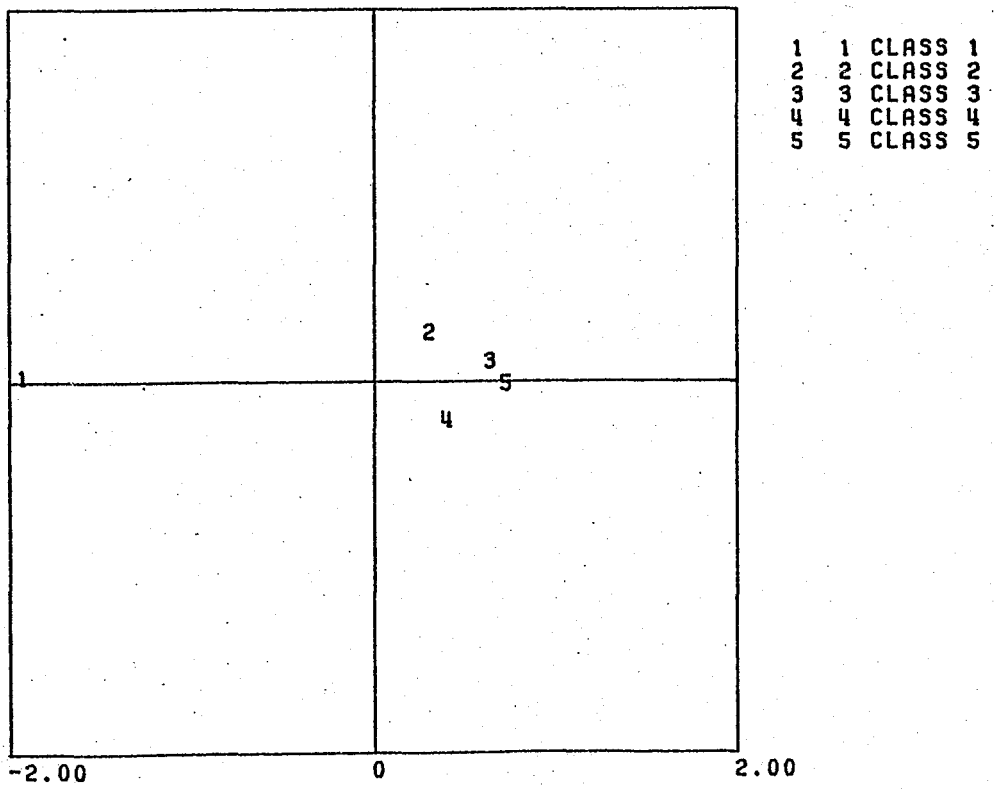


FIGURE 5.22: NMMS PLOT - SOCIAL CLASSES: MARRIAGE EXCHANGE



partly be the result of the difficulties encountered in determining social class.

Class, Occupation and Origin

All the class data were considered as a whole in these computations but as Harrison also noted in the Otmoor study, there was a differentiation in class composition between study area residents and non-residents. Classes III and II outnumbered classes IV, V and I amongst individuals of the outside world while Class IV predominated amongst the residents (see 5.24 below).

Table 5.24 Class and Origin

Groom's Origin	Groom's Social Class					
	Tot	I	II	III	IV	V
Study Area	3590	14 .4%	171 4.8%	669 18.6%	2431 67.7%	305 8.5%
Outside World	272	16 5.9%	73 26.8%	96 35.3%	67 24.6%	20 7.4%

A chi square test confirmed the significance of these

distributions (X^2=402, p=0) which suggests the possibility that higher social class is associated with greater movement at marriage. Further investigation showed statistically significant differences between social class frequencies of grooms from 'nearby' and study area (X^2=106, p=0) and between occupational group frequencies of grooms resident in the outside world and in the study area (X^2=284, p=0). There were far less miners but more agriculturalists, shopkeepers, and those engaged in crafts and the professions amongst the outside world grooms.

Following these observations, is there differentiation in spatial endogamy between the occupational and social class groups? The proportion of parish endogamous marriages was computed for each group using the groom's occupation. Heading the list were the miners and seamen with a value of 92% and the labourers (89%), while the prof/clerical group, the agriculturalists and shopkeepers were the least geographically endogamous with rates of 68%, 66% and 66% respectively. It appears that miners are both spatially and occupationally highly endogamous. But which is the stronger force? They are mainly concentrated in large populous towns with little need to search outside for a suitable marriage partner, but in a more agricultural area are they as highly geographically endogamous? A breakdown of parish endogamy by occupation in each parish brought to light a remarkable differentiation (Table 5.24b). The most obvious change in the rate of endogamy was indeed that of

the miners marrying in Castle Eden parish. Only one out of sixteen marriages in which the groom was a miner was endogamous and the rate was far below the over-all endogamy rate of 38%. In the majority of the exogamous marriages, the non-Castle Eden partner was of a mining family. It appears that the strong postive assortment for occupation encouraged spatial exogamy. The sea-faring group was also highly spatially endogamous in Dalton-le-Dale parish but was much less so where it was numerically less strong. The endogamy rate for the agricultural group was also lower in Castle Eden than any other parish but it was still higher than the average rate and concomitantly lower in the mining parishes.

TABLE 5.24b. Spatial Endogamy in the Parishes

Occupation	Seaham	D-le-D	Easing	C.E.
Miner	86%	91%	96%	6%
Seamen	38	96	69	50
Agrics	68	67	72	43
Shopks	30	79	67	25
Indust	38	89	90	24
Crafts	61	89	82	56
Prof/Cler	50	77	60	63
Labourers	70	94	89	58

Age at Marriage

Age at marriage is often associated with an increase in marriage distance, and this phenomenon was pursued here. Data on age at marriage was only collected from the Easington Parish registers and was available from 1837 onwards. Of the 3086 individuals married in this period the exact age was recorded for only 36%. In the other cases over- or under-21 was specified or ommitted completely (2%). 33.5% of all brides (N=1511) who gave some information on age were under 21, as opposed to only 11.5% of the grooms. Analysis of exact age at marriage revealed the following:

Table 5.27 AGE AT MARRIAGE

a) Age at First Marriage

	range	mean	sd
males (N=500)	17-50	22.73	+3.61
females (N=602)	16-33	20.32	+2.56

b) Age at Subsequent Marriages

	range	mean	sd
males (N=29)	24-69	34.69	+9.99
females (N=30)	20-71	34.07	+11.63

First marriages occurred at an early age in Easington compared to England and Wales. In the 1871 report given by the Registrar General, 25.8 was the average age of men at first marriage and 24.4 of women. He also commented that County Durham had the highest proportion of men under-21 marrying.

There were differences in the mean age at first marriage of brides and grooms between social classes and occupational groups. The professional/clerical group married earliest, an average of 22.0 for grooms and 19.5 for brides, compared to the agricultural and crafts groups who married at a mean age of 24.0 (grooms) and 21.8 (brides) but the professional group was so small that these results may be unrepresentative (grooms, N=11; brides, N=4). Brides and grooms of the miner group married at the second lowest age: 22.5 for men, 20.0 for women. Age at marriage decreased slightly from Class I (groom=23.6) to Class V (groom=22.6) and groom's age at marriage of all classes and occupations decreased from 24.1 to 22.8, over the four decades. Significantly, migrants to Easington were clearly older at marriage on average than Easington residents: Easington groom's age=22.6, migrant groom's age=26.4; Easington bride's age=20.3 and migrant bride's age=21.1.

It would have been useful to have compared these results with those obtained from other parishes, but the data were not collected. Nevertheless, the sample was fairly large and it is

fair to suggest that the observed discrepancies in mean age at marriage within social classes and occupational groups might be applicable to at least the other two mining parishes in the study area. Further, these results combined with earlier analyses of differentiation in social class distributions indicate that the partners of exogamous marriages were more likely to be older at marriage and of a higher social class.

Annual distribution of marriages

Although it is difficult to predict the genetical consequences, the distribution of marriages throughout the year is of great interest because of its uneveness. Figure 5.23 shows that the main peak was in December followed by May, but when the data was divided into early and late periods frequencies changed. May is by far the the most popular month for marriage in the early period (20%, see Figure 5.24); while distribution is more even in the late period, December is the most frequent month of marriage (12%). Differences in frequencies of occupational groups appear to be the main cause of this shift in popularity as May was found to be the most popular month for agricultural workers (18%, Figure 5.25) and December for miners (12.7%). The chi square value for groom's occupation and month was highly significant ($p=0.0003$) while that of bride's father and month was less so ($p=0.0189$). Individual parishes showed similar results:

May was always most popular in the early period and normally for where the groom was involved in agricultural work. May was still predominant in the only parish to be rural in the late period (see Figure 5.26) while December and March were more frequent amongst the mining parishes at this time.

These results are compatible with those of Wrigley and Schofield (op. cit.) who analysed 404 parishes in England and Wales and found that April and May were the most popular months by the mid-seventeenth century. Their explanation was that most of the annual hirings occurred on May Day, so this would be a time of mobility, suitable for a change in life-style. It also coincides with the slack period after lambing and calving. Economic conditions could also explain the peak in December for miners. Although their annual bond began in April, December and January were slack periods in the coal trade and would be a convenient time to make all the preparations necessary for a wedding. Constable's results from Pocklington, an agricultural area were very different: the main peaks were in November and December rather than May, but again this was a slack time after the crops harvest.

FIGURE 5.23: MONTH OF MARRIAGE - ALL CASES

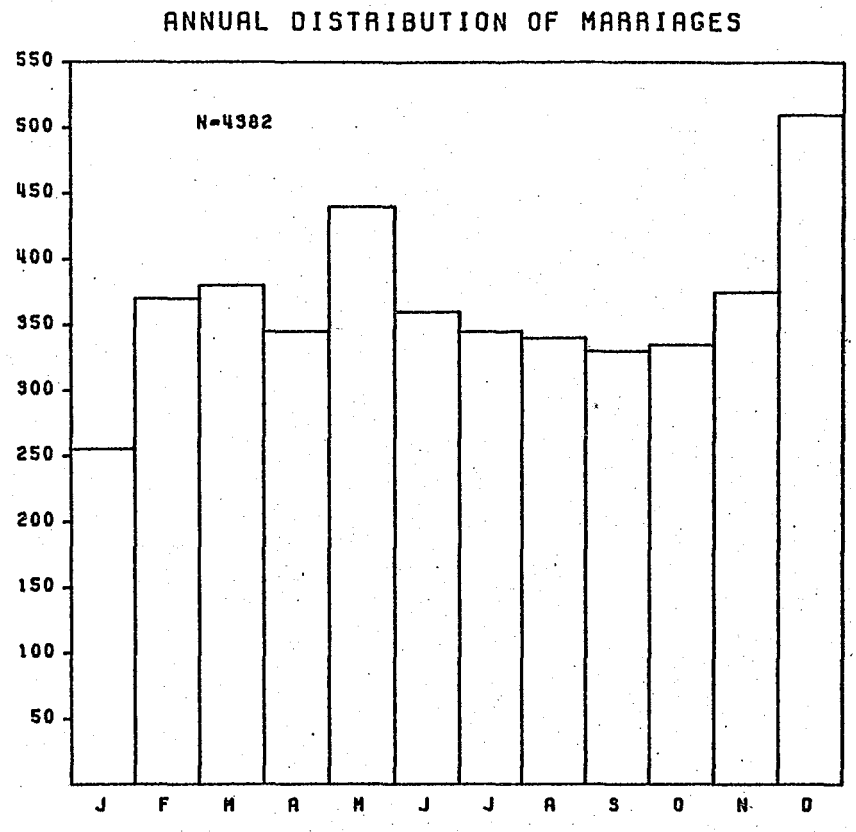


FIGURE 5.24: MONTH OF MARRIAGE - EARLY & LATE PERIODS

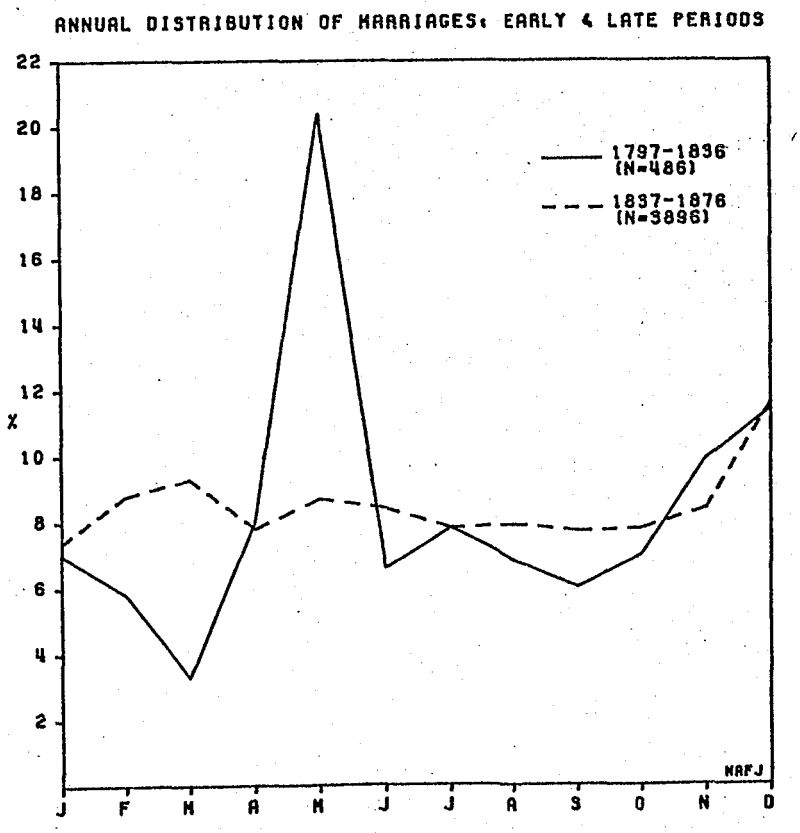


FIGURE 5.25: MONTH OF MARRIAGE - OCCUPATIONS

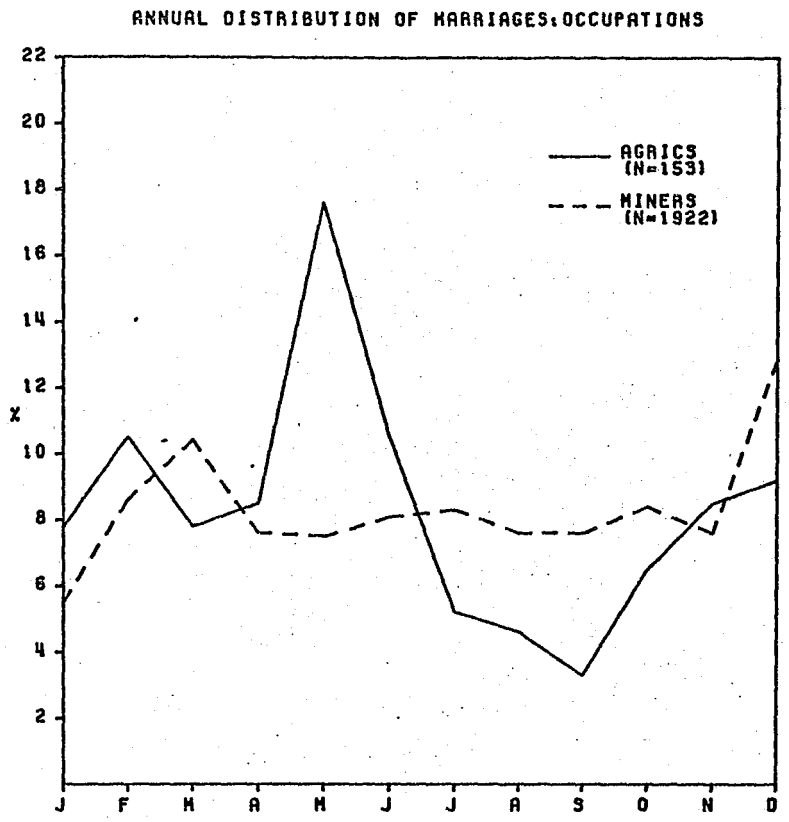
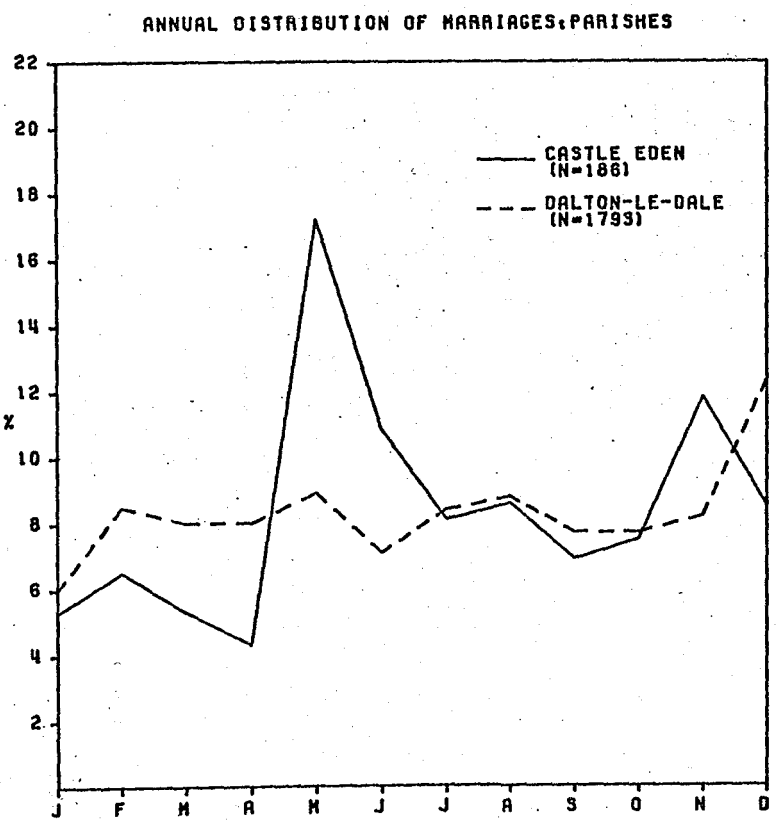


FIGURE 5.26: MONTH OF MARRIAGE - PARISHES



1851 CENSUS ANALYSIS

In 1851 the total population of the study area was 13,607 and there were 2116 cases where both husband and wife were present and could be included in the analysis of birthplace distance. When including all children, a total of 10,048 individuals were coded (74% of the total population), and it is important to remember that the adults represented the majority of the breeding population of the area. Of these 808, couples and their families lived in Dalton-le-Dale Parish, 1137 in Easington, 96 in Seaham and 75 in Castle Eden.

Birthplaces of Husbands and Wives

Residents were asked for both their county and their parish or town of birth, but this information was occasionally omitted or more frequently incomplete. County of birth is tabulated in 5.28 and displayed on Maps 5.1-5.4. Maps 5.1 and 5.2 utilise virtually all the data as county was nearly always supplied but only those cases which could be given a specific national grid reference were included on Maps 5.3 and 5.4. Nevertheless, these latter two display the distribution of birthplaces most effectively; it is remarkably wide-ranging, extending between Shetland and Jersey and covering most of the counties of England. Migration into the north-east, in terms of the proportion of

KEY

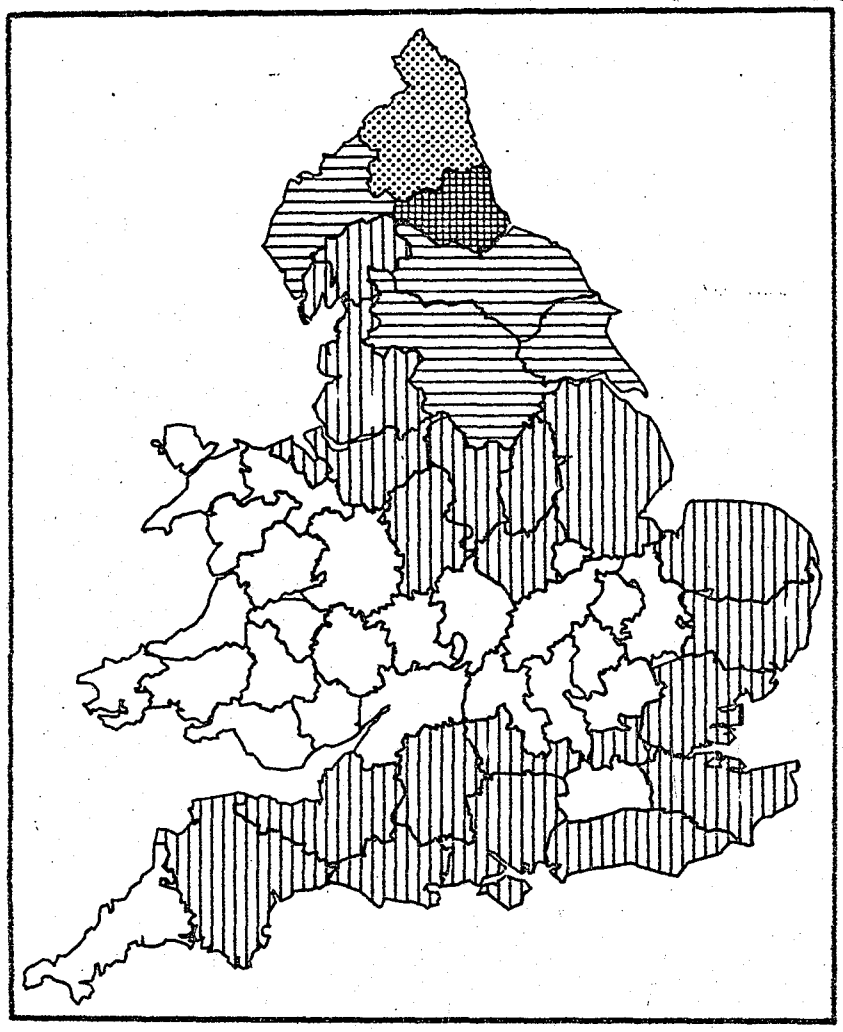
NONE

0-0.9%

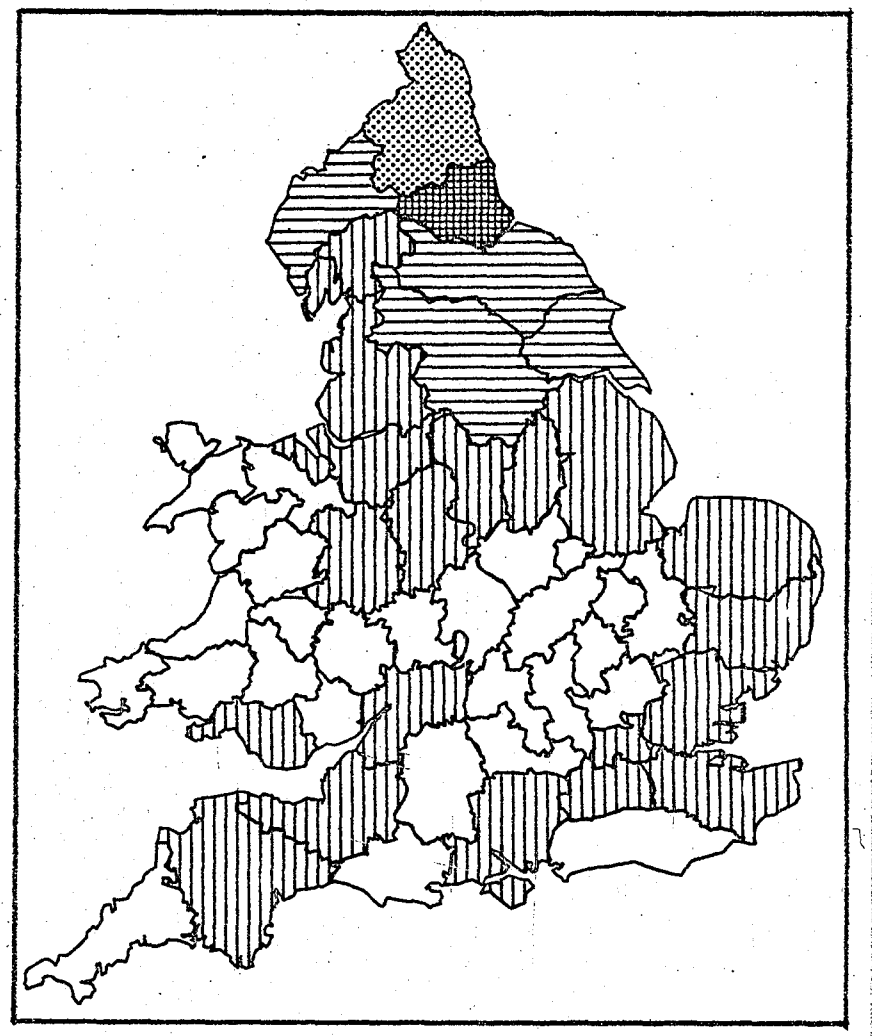
1-9%

20-29%

60-69%



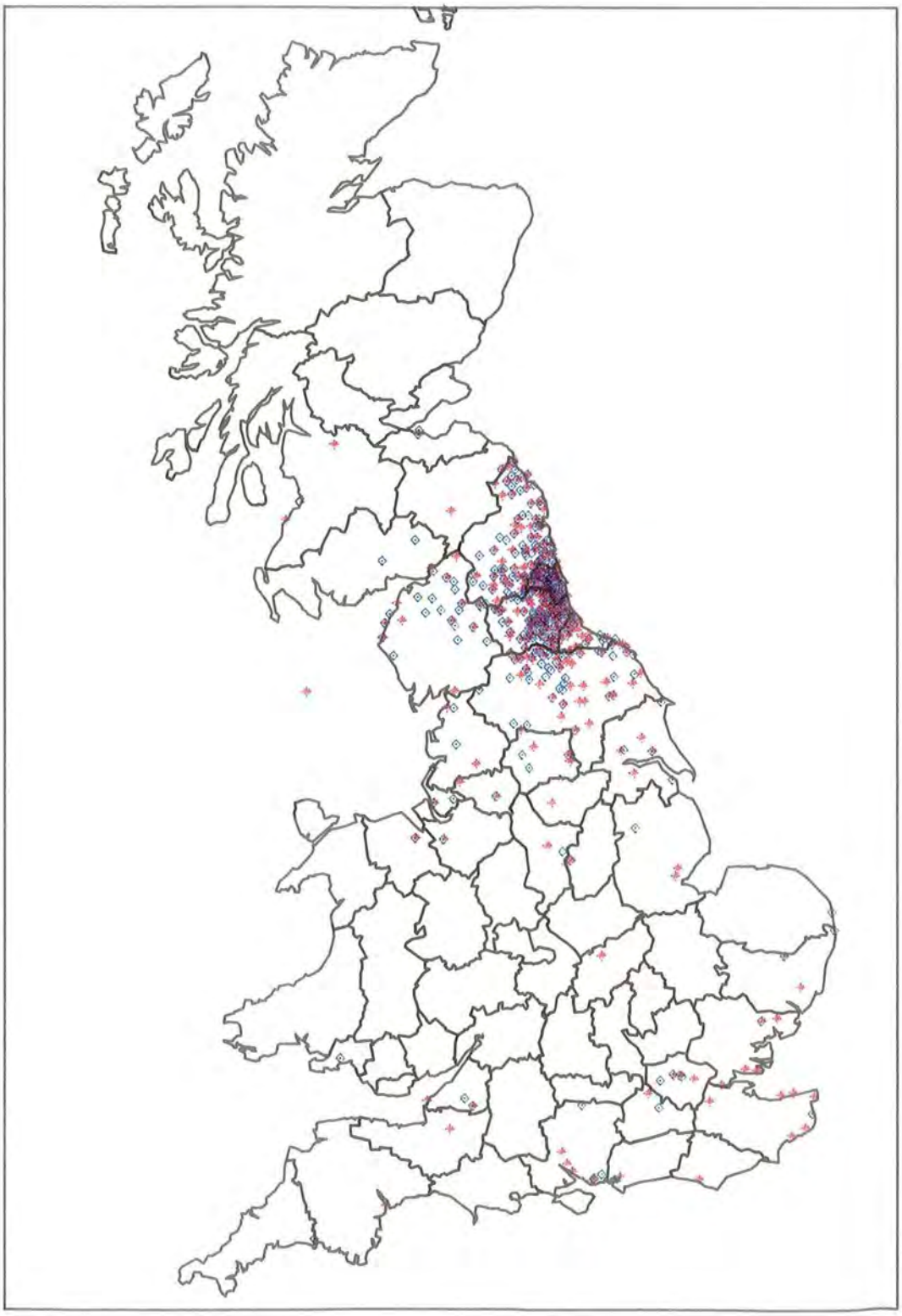
Map 5.1: FREQUENCY DISTRIBUTION OF MEN'S BIRTHPLACES



Map 5.2: FREQUENCY DISTRIBUTION OF WOMEN'S BIRTHPLACES

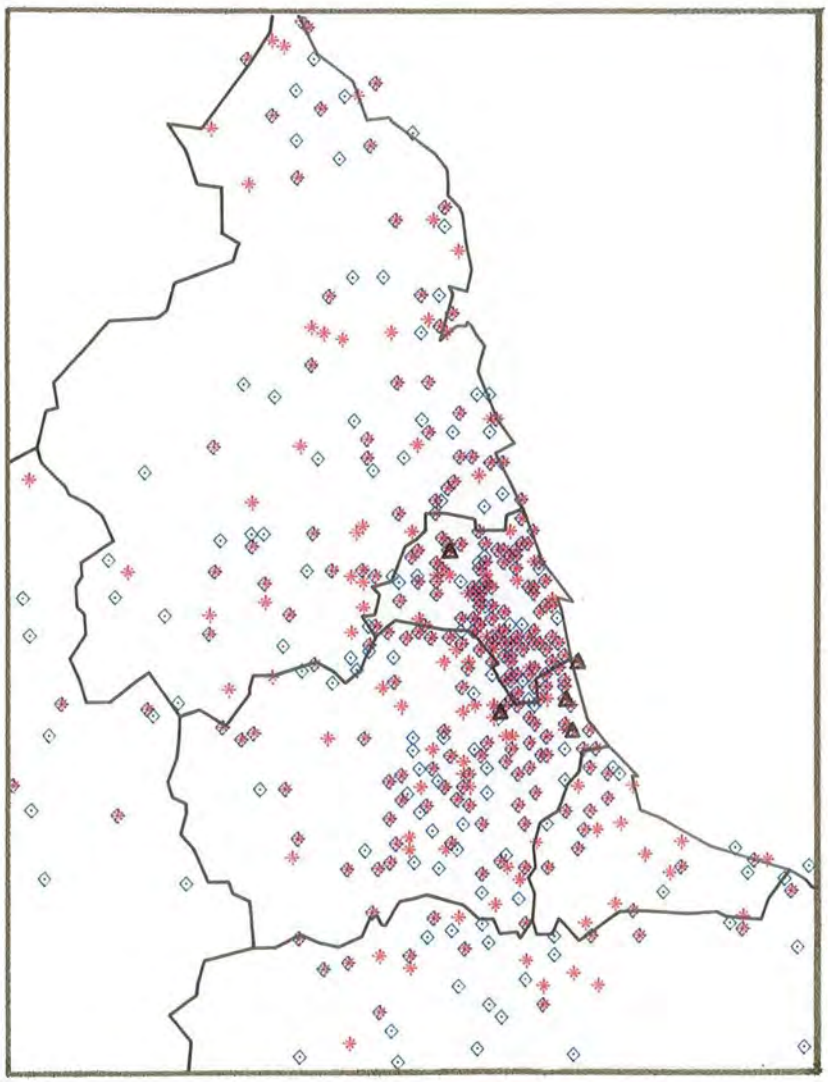
MAP 5.3: POINT DISTRIBUTION OF BIRTHPLACES OF MEN & WOMEN

Red stars = men's birthplaces
Blue diamonds = women's birthplaces



MAP 5.4: BIRTHPLACES OF MEN & WOMEN BORN IN THE NORTH-EAST

Red stars = men's birthplaces
Blue diamonds = women's birthplaces
Black triangles = (from north to south)-
Newcastle, Seaham Harbour, Easington, Durham City and Castle Eden.



total increase in population, was one of the highest in the decade 1841-1851 and this is particularly evident in the study area where only 275 or 6.5% of residents were born here but the

Table 5.28 County of Birth: Husbands and Wives

County/ Region	Husband N=2108	Wife N=2112
Study Area	6.6%	6.4%
Rest of Durham	53.5%	55.6%
Northumberland	23.3%	23.0%
Yorkshire	6.1%	5.6%
Scotland	2.7%	1.9%
Ireland	1.9%	1.9%
Cumberland	1.6%	1.8%
(Northern Cos	8.2%	8.0%)
(Cumb, Westmor, Lancs, Yorks)		
Rest of E & W	3.6%	2.9%
Abroad	0.2%	0.2%
British Subject	0.1%	0.1%

majority of migrants came from Durham and its surrounding counties -'northerners' accounted for 91.6% of men and 93% of women. Men and women differed little in proportions born in Durham, other northern counties, Scotland and Ireland but men

came from a wider area, covering 32 counties in total compared to 26.

When the birthplaces of residents of the four parishes are compared, the by now familiar differentiation between Castle Eden and the other parishes appears (Table 5.29). A much higher percentage were actually born in Castle Eden and the rest of County Durham and more were born in Yorkshire than Northumberland. There are some significant differences within the 'mining' parishes however: only a tiny fraction of Dalton-le-Dale residents were native to the parish but migrants came from all over Britain from as far north as Shetland and as far south as Jersy, representing a greater number of counties than Easington which was of a similar population size. This is undoubtedly a reflection of its more diverse economy with those engaged in seafaring contributing most to this dispersed pattern of distribution. Also birthplace by county frequencies in Seaham resemble those of Castle Eden to a greater degree than the other parishes, probably because coal-mining was still relatively new to this parish in 1851.

If we consider birthplace distributions within County Durham, the neighbouring parish of Houghton-le-Spring is prominent as are the populous parishes of Sunderland and Chester-le-Street, and the order of parishes by frequency is exactly the same for men and women. It is notable that in agricultural Seaham and Castle

Table 5.29 BIRTHPLACES BY COUNTY IN THE FOUR PARISHES

Men's Birthplace	Sea	DleD	Eas	C.E.
% in Parish	8.5	2	6.5	12
% rest of Durham	59.5	55	54.5	63
% Durham Co.	68	57	61	75
% North. Co.	21	18	28	9
% Yorks	4	8	5	11
% Scotland	2	4	2	3
% Ireland	0	3.5	1	0
% Wales	0	0	0.4	0
% Northern Cos	93	85.5	96	97
% Rest of England	4	7	0.6	0
% Abroad	1	0	0	0
No. of Counties	6	27	18	5

Wife's Birthplace	Sea	DleD	Eas	C.E.
% in Parish	3	2	6.5	12
% Rest of Durham	63	60	54.5	56
% Durham Co.	66	62	61	68
% North	20	18	28	11
% Yorks	2	7	5	11
% Scotland	1	3	1	4
% Ireland	1	3	1	0
% Wales	0	0.1	0.4	0
% Northern Cos	91	89.5	96.5	94
% Rest of England	5	3.9	1.1	2
% Abroad	2	0.5	0	0
No. of Counties represented	10	24	20	8

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NB Northern Counties = Durham, Northumberland, Cumberland, Yorkshire, Westmoreland, Lancashire.

'No. of Counties' includes Scotland, Ireland and Wales.

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Table 5.30 DURHAM BIRTHPLACES BY PARISH OF STUDY AREA RESIDENTS

a) Men's Birthplaces (% of those born in Durham Co.)

Seaham N=59		D-le-D N=438		Eas N=654		C.E. N=53		Study Area N=1204	
13	Seaham	19	Sunderland	22	H-Le-Sp	19	C.E.	H-Le-Sp	19
10	Houghton LS	18	H-Le-Sp	15	C-Le-St	11	H-Le-Sp	13	C-Le-St
8.5	Chester LS	11	C-Le-St	11	Eas	9	Eas	8	Sunderland
8.5	Lanchester	8	S. Shields	6	Jarrow	6	C-Le-St	8	Easington
								5	Jarrow
27	parishes total	51	parishes total	55	parishes total	25	parishes total	67	pars total

b) Women's Birthplaces (% of those born in Durham Co.)

Seaham N=58		D-Le-D N=480		Eas N=673		C.E. N=49		Study Area N=1260	
22	C-Le-St	21	Sunderland	24	H-Le-Sp	16	C.E.	20	H-Le-Sp
15	H-Le-Sp	15	H-Le-Sp	14	C-Le-St	14	H-Le-Sp	13	C-Le-St
5	Washington	11	C-Le-St	11	Eas	8	C-Le-St	9	Sunderland
5	Lanchester	7.5	S.Shields	7	Jarrow	6	Kelloe	7	Easington
5	Seaham	5	Jarrow			6	Monk Heseld	6	Jarrow
25	pars total	50	pars total	53	pars total	22	pars total	62	pars total

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NB H-Le-Sp is Houghton-Le-Spring, C-Le-St is Chester-Le-Street

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Eden the highest numbers came from their own parishes. Again male and female distributions are very similar apart from the much lower number of indigenous women in Seaham Parish (Table 5.30).

We can examine birthplace a little more closely by dividing the area into settlements (see Table 5.31): as far as it was possible the collieries were separated from the villages, but Haswell was considered as a whole as were Seaham village and Seaham and Seaton Collieries. Many surrounding farmsteads, officially part of Easington township, were included with Hawthorne on geographical grounds. Clearly there is differentiation between the villages, Seaham Harbour, and the collieries which was confirmed by a chi square test ($X = 225$, $p=0$, Table 5.32). In the villages a much greater frequency were born in Durham and Yorkshire, a lower frequency in Northumberland. Maps 5.5-5.7 effectively display the tendency for the collieries and Seaham Harbour to attract migrants from a wider radius. This differentiation is hardly surprising, considering the development of the area but the low numbers of 'sedentary' people in the villages shows that mobility was high amongst the rural population although movement was over a smaller area. Sedentism is remarkably differentiated between the villages however: the populous village of Easington exhibits the highest frequency, followed some way behind by Castle Eden and Shotton village. It is probably not coincidental that these are also the largest

Table 5.31 COUNTY OF BIRTH: TOWNSHIPS. ALL INDIVIDUALS.

Birthplace %	Seaton N=60	D-Le-D V. N=26	C. Hes N=24	Mur V. N=30	Eas V. N=187	Haw N=130	Shot V. N=88
Co.Durham	77	81	79	73	79	73	72
Northumberland	17	12	17	7	7	15	17
Yorkshire	3	7	4	17	7	9	9
Scotland	0	0	0	0	0	2	0
Ireland	1.5	0	0	0	3	0	2
Northern Cos	97	100	100	97	96	98	98
Rest of England	0	0	0	0	0.5	0	0
Abroad	1.5	0	0	3	0.5	0	0
Township	8	4	0	7	30	8	10
No. of Counties	4	3	3	3	8	5	4

Birthplace %	Seaham N=130	Murton C. N=383	Sea Har N=1149	Shot C. N=413	S. Hett N=717	Hasw N=238	C.E. N=150
Co. Durham	62	61	58	46	58	68	71
Northumberland	23	29	14	42	30	20	10
Yorkshire	3	3	8	6	3	4	11
Scotland	2	1	5	2	1	1	3
Ireland	0	0.3	5	0.5	1	2	0
Northern Cos	91	97	83	96	95	95	95
Rest of Eng	5	1.7	7	1.5	3	2	2
Abroad	2	0	0	0	0	0	0
Township	3	(none)	(13 ind)	(none)	(5 inds)	(none)	12
No. of Counties	9	15	28	14	15	11	8

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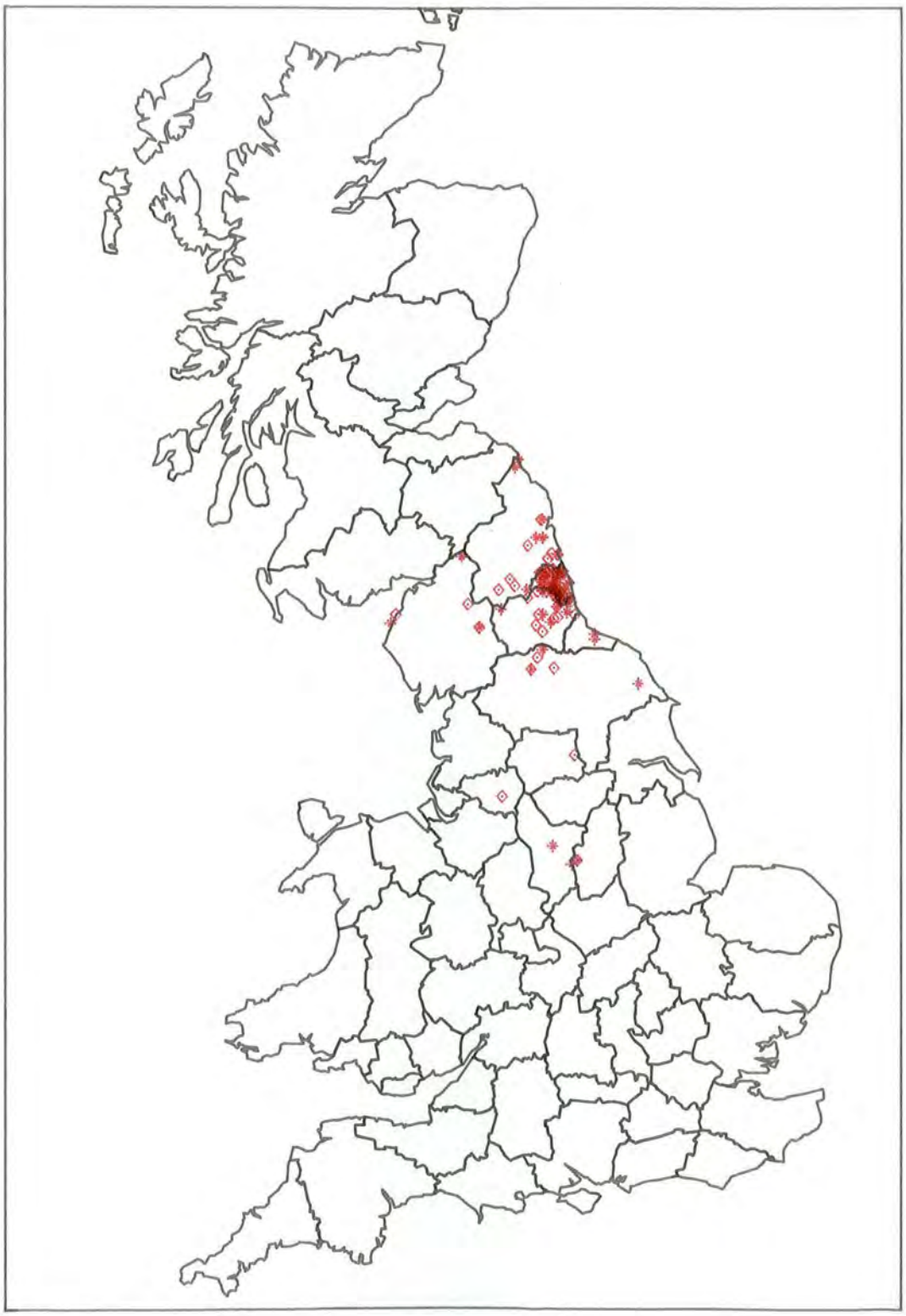
villages in the area in terms of population numbers. Proportions born in Seaham Harbour and the Collieries are meaningless as they had only been in existence for about twenty years! The concentration of Irish-born in Seaham Harbour and their poor representation in the villages and collieries is compatible with Cooter (1972), and it is notable that the Scots were also proportionately strongest in Seaham Harbour.

Table 5.32 BIRTHPLACES: VILLAGES, COLLIERIES & SEAHAM HARBOUR MEN ONLY

	Dur	North	Yorks	N.C.	Scot	Ire	Rest	Tot
Vills	269	39	28	3	4	3	0	346
Expect	206	78	23	7	10	8	15	
Row%	78	11	8	1	1	1	0	
S.H.	308	87	54	14	30	28	54	575
Expect	342	130	37	39	64	76	24	
Row%	54	15	9	2	5	5	9	
Colls	419	254	27	19	13	6	17	755
Expect	449	171	49	16	21	17	32	
Row%	56	34	4	3	2	1	2	
N.B. N.C. = Other northern Counties.								

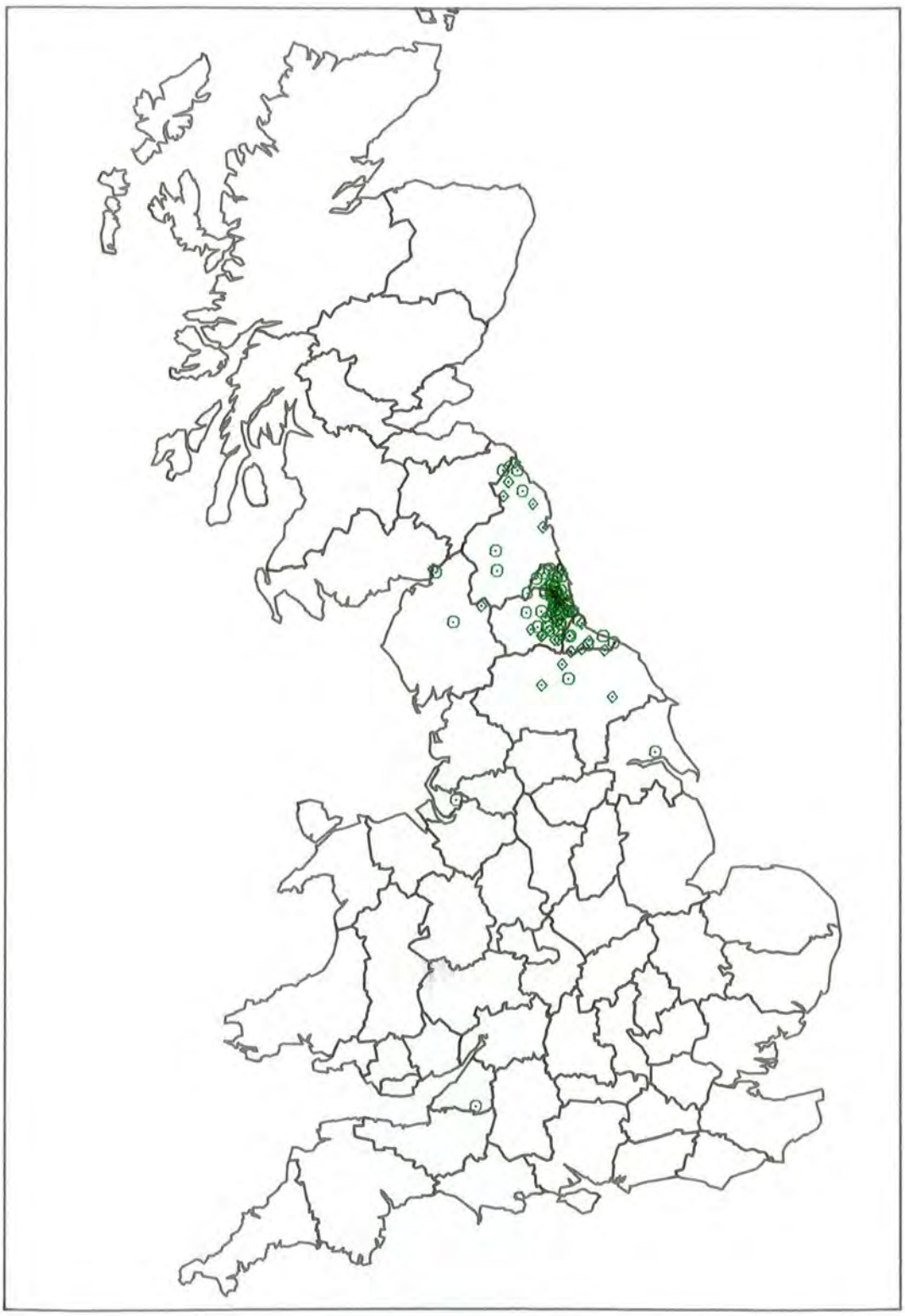
MAP 5.5: BIRTHPLACES OF MURTON COLLIERY RESIDENTS

stars = men's birthplaces
diamonds = women's birthplaces



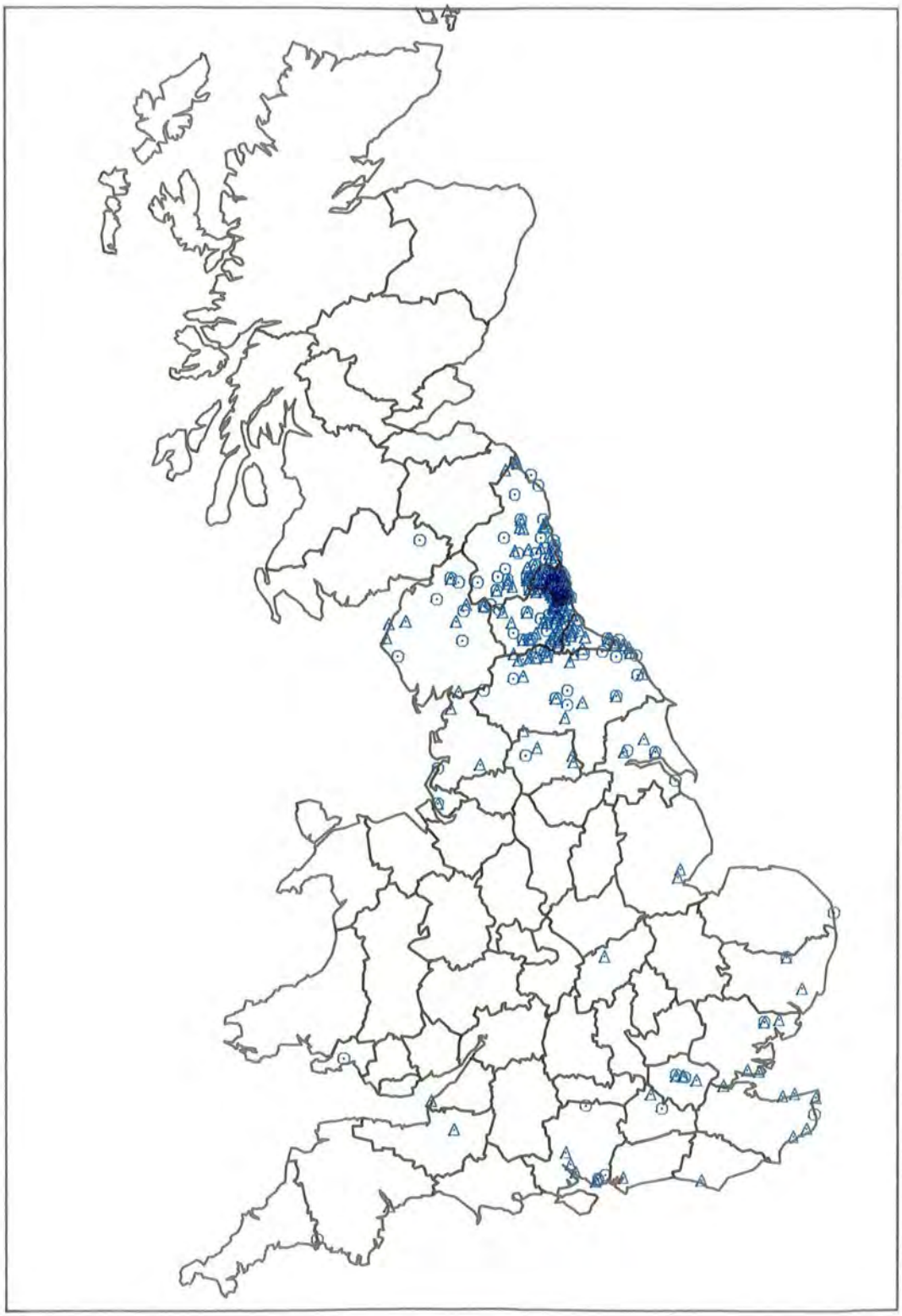
MAP 5.6: BIRTHPLACES OF CASTLE EDEN RESIDENTS

circles = men's birthplaces
diamonds = women's birthplaces



MAP 5.7: BIRTHPLACES OF SEAHAM HARBOUR RESIDENTS

triangles = men's birthplaces
circles = women's birthplaces



Occupation and Social Class

Tables 5.33-6 display occupation and social class distributions in the parishes and townships. The predominance of sea-faring over mining in Seaham Harbour at this time is very clear, and only one mariner lived outside the town, in Haswell. Very few miners lived outside the collieries but surprisingly, some agriculturalists lived in the town of Seaham Harbour (many of these were Irish) and in the collieries. Social Class I forms a conspicuously high proportion of Dalton-le-Dale village residents and all the villages have high frequencies of Social Class II by virtue of the number of farmers there. But it would not be fair to regard the differing distributions of the social classes as being important because of the crude way of categorising social class; the distributions of occupational groups is much more relevant to this analysis.

Comparison of birthplace (by county) and occupation (Tables 5.37-9 and Maps 5.8-5.18) show that it was much more likely that a member of the agricultural group would be born in the study area than a member of any other occupational group. The other traditional occupations, crafts and labourers, also show relatively lower mobility but these groups are more mobile than might have been expected. Birthplaces of sailors were much more widely dispersed across the country than occupation groups of a larger size; a significantly lower number were born in the north

Table 5.33 OCCUPATION IN THE FOUR PARISHES

Occupation %	Sea	DleD	Eas	C.E.	St. Ar.
Miner	26	32	61	12	46.3
Mariner	0	26	0.1	0	10.1
Agricultural	33	8	12	39	12.5
Shopkeeper	2	6	4	5	4.7
Industrial	15	11	5	16	8.4
Crafts	15	14	10	15	12.1
Professional	1	2	2	4	2
Labourer	9	1	5	9	3.9
Number	94	805	1130	75	2104
Missing	2	3	7	0	12

Table 5.34 SOCIAL CLASS IN THE FOUR PARISHES

Social Class	Sea	DleD	Eas	C.E.	St. Ar.
% Class I	1	1	0.5	1	0.5
% Class II	20	16	11	15	13.5
% Class III	27	22	14	23	17.9
% Class IV	43	57	69	49	62.7
% Class V	8	4	5.5	12	5.5
Number	94	805	1130	75	2104
Missing	2	3	7	0	12

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Table 5.35 OCCUPATION FREQUENCIES IN THE TOWNSHIPS

Occupation	Seat	DleD	C.Hes	Mur V.	Eas V.	Haw	Shot V.
% Miners	7	15	33	0	1	6	13
% Mariners	0	0	0	0	0	0	0
% Shopkeepers	3	0	8	0	9	6	9
% Agricultural	53	46	42	53	48	65	48
% Industrial	20	8	0	27	0	3	18
% Crafts	17	23	8	13	33	6	7
% Professional	0	8	0	7	6	5	2
% Labourer	0	0	8	0	3	9	2
Number	30	13	12	15	92	66	44

Occupation	Seah	Mur C.	Sea Har	Shot C.	S. Het	Hasw	C.E.
% Miners	34	80	17	83	80	62	12
% Mariners	0	0	37	0	0	0.2	0
% Shopkeepers	1.5	2	8	3	2	4	5
% Agricultural	23	6	6	2	1	6	39
% Industrial	15	9	12	3	5	7	16
% Crafts	15	4	17	5	9	11	15
% Professional	1.5	0.5	2	1	2	1	4
% Labourers	9	0	1	3	3	9	9
Number	64	193	572	206	357	119	75

Table 5.36 SOCIAL CLASS FREQUENCIES IN THE TOWNSHIPS

Social Class	Seat N=30	DleD N=13	C.Hes N=12	Mur V. N=15	Eas V. N=92	Haw N=65	Shot V. N=44
% Class I	0	23	0	0	2	2	0
% Class II	47	38.5	33	33	25	59	34
% Class III	13	38.5	8.5	20	28	12	23
% Class IV	40	0	50	47	41	18	34
% Class V	0	0	8.5	0	3	9	9

Social Class	Seah N=64	Mur C. N=193	Sea Har N=572	Shot C. N=206	S.Hett N=357	Hasw N=119	C.E. N=75
% Class I	1.5	0	1	0	0.3	0	1
% Class II	8	3	19	4	3	8	15
% Class III	34	11	25	8	14	13	23
% Class IV	45	86	49	85	80	70	49
% Class V	12	0	5	3	3	9	12

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and more in the southern and eastern coastal ports. Most Durham seamen were born in the rival ports of South Shields and Sunderland (66%) while North Shields and Newcastle accounted for many Northumbrian sailors (42%).

A close-up of the distribution of miners (in Map 5.15) indicates concentrations on the Tyne and Wear districts. Virtually all north-eastern miners were born somewhere on the coalfield -further evidence of the small mumbers of miners with a rural origin, and particular collieries were prominent: Hetton in Durham; Long Benton, Wallsend and North Shields in Northumberland. These distributions correspond closely with Sill's analysis of Hetton-le-Hole in 1851 and it is interesting that many moved from there to the study area collieries. A chi square test proved the significance of the differing distributions of birthplace (by county) in each occupation, X^2 =491, p=0.

There were some minor differences between parishes in birthplaces of the occupational groups. More agriculturalists in Seaham and Dalton-le-Dale came from Northumberland but Yorkshiremen were more prominent amongst this group in Easington and Castle Eden, which conforms with their spatial location.

These differing birthplace patterns across the occupational strata are also brought out in the birthplace distributions of

Table 5.37 BIRTHPLACE AND OCCUPATION: ALL PARISHES COMBINED

Birthplace	Miner	Seamen	Agric	Shopks	Indust	Crafts	Prof	Lab
% Study Area	2	0.5	21	8	4	14	7	15
% Rest of Durham	55	50	50	52	60	55	38	45
% Co. Durham	57	50.5	71	60	64	69	45	60
% North Co.	34	12	9	21	18	12	19	22
% Yorks	3	7	13	9	5	9	11	9
% Scotland	1.5	9.5	1.5	1	3.5	4	7	1
% Ireland	1	1.5	3	1	5	2	5	4
% Wales	0.3	0	0.4	0	0	0	0	0
% Other North. Cos	2	2	2	4	1.5	1.5	5	5
% Rest of Eng.	1.5	17.5	0	4	3	1.5	7	0
% Tot North Cos	96	71.5	95	84	88.5	91.5	80	96
% Abroad	0.1	0	0.5	0	0	0.5	2	0
Number	969	212	262	99	176	254	42	82
No. Counties represented	17	23	8	10	11	10	10	7

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Table 5.38 DURHAM BIRTHPLACES AND OCCUPATION: ALL PARISHES

Miners N=519	Seamen N=107	Agrics N=176	Shopks N=56
29.3% H-Le-Sp	42.1% Sunder	18.8% Easing	16.1% C-Le-St
20.0% C-Le-St	24.3% S.Shields	5.1% DleD	14.3% Sunder
7.5% Washing	4.7% Monkwear	4.5% Kelloe	10.7% H-LeSp
7.3% Jarrow		4.0% Seaham	10.7% Easing
5.6% Gateshead			
42 pars repres	22 pars repres	50 pars repres	23 pars repres

Indust N=107	Crafts N=169	Prof N=20	Labs N=43
20.6% H-Le-Sp	20.7% H-Le-Sp	16.7% H-Le-Sp	18.6% Easing
13.1% C-Le-St	13.6% Easing	11.1% Easing	9.3% H-Le-Sp
5.6% Sunder	11.2% Sunder		9.3% Jarrow
5.6% Jarrow	7.7% C-Le-St		
39 pars repres	42 pars repres	16 pars repres	24 pars repres

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Table 5.39 SOCIAL CLASS AND BIRTHPLACE BY COUNTY

Social Class

Birth-place	I	II	III	IV	V	Total
Durham	3	199	252	744	63	1261
Expect	6	171	226	790	69	
Col%	30.0	70.0	67.4	56.8	3.0	
North	2	41	64	362	19	488
Expect	2	66	87	306	27	
Col%	20	14.5	17.1	27.6	16.7	
Yorks	1	21	27	67	11	127
Expect	1	17	23	80	7	
Col%	10.0	7.4	7.2	5.1	9.6	
Nor Cos	0	5	5	29	6	45
Expect	0	6	8	28	2	
Col%	0	1.8	1.3	2.2	5.3	
Scotland	2	4	12	35	3	56
Expect	0	8	10	35	3	
Col%	20.0	1.4	3.2	2.7	2.6	
Ireland	0	1	5	22	11	39
Expect	0	5	7	24	2	
Col%	0	0.4	1.3	1.7	9.6	
Rest E & W	2	12	9	51	1	75
Expect	0	10	13	47	4	
Col%	20.0	4.2	2.4	3.9	0.9	
Total	10	283	374	1310	114	2091

N=2091, Degrees of Freedom=24 Chi-square=120.54 p=0.0000

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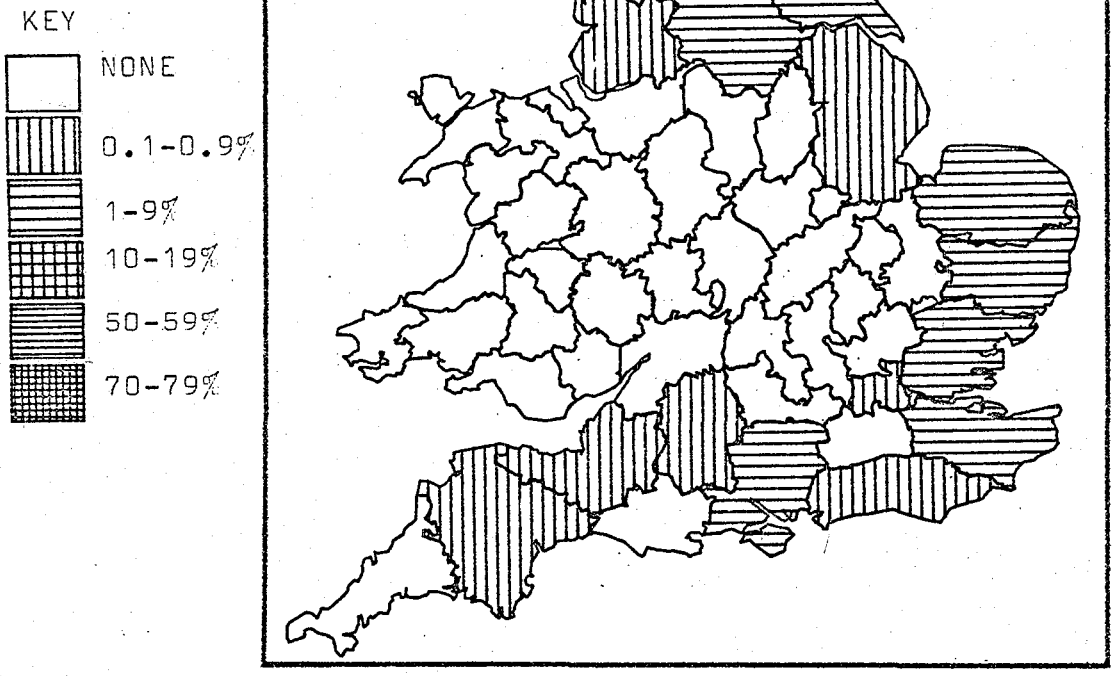
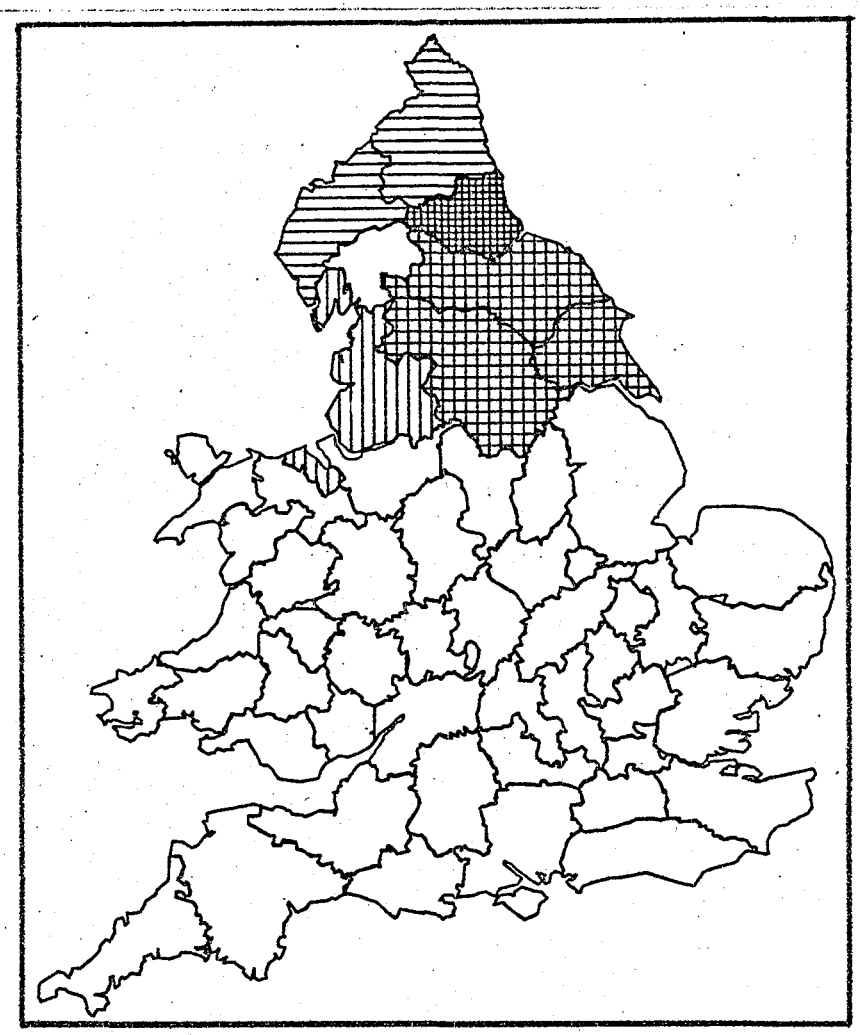
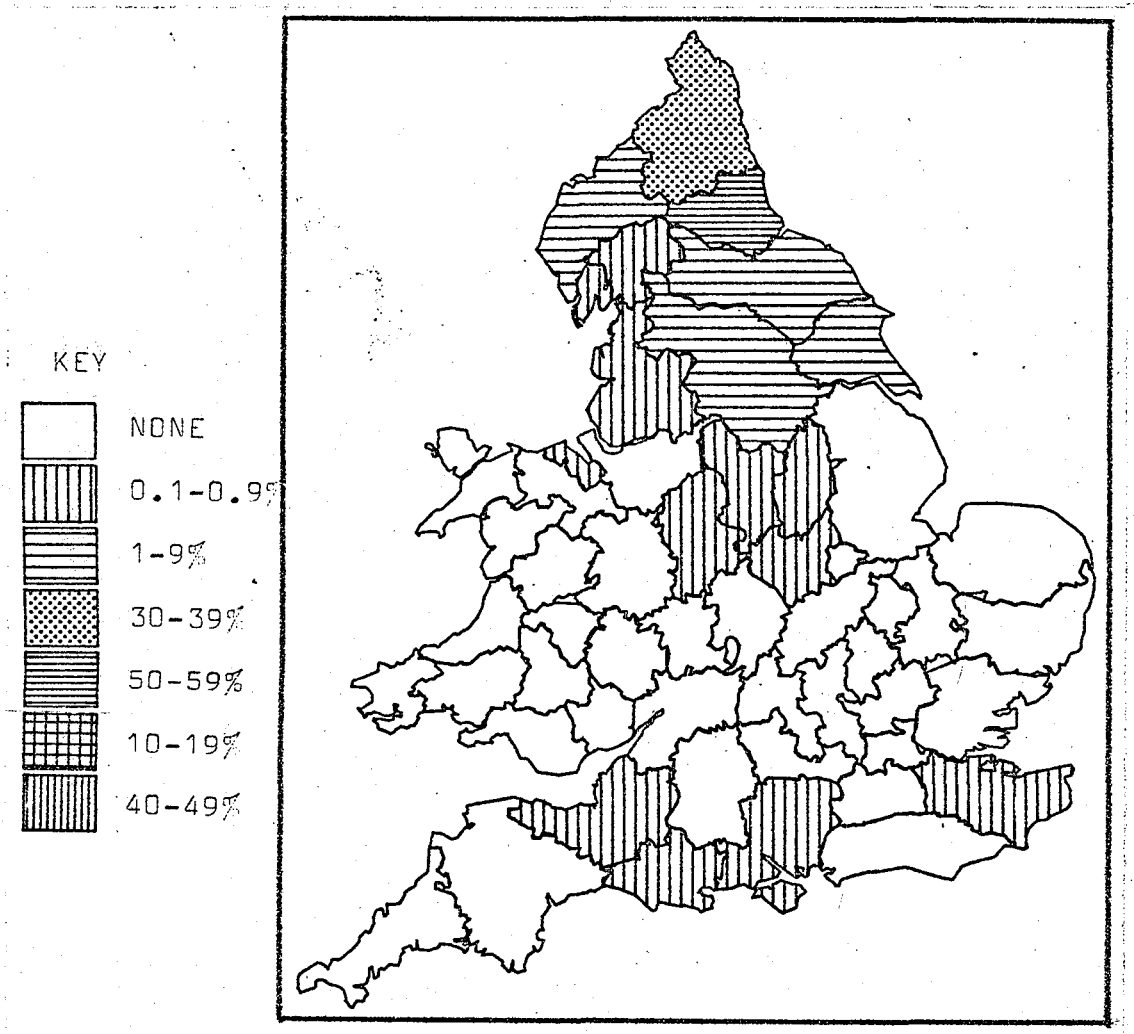


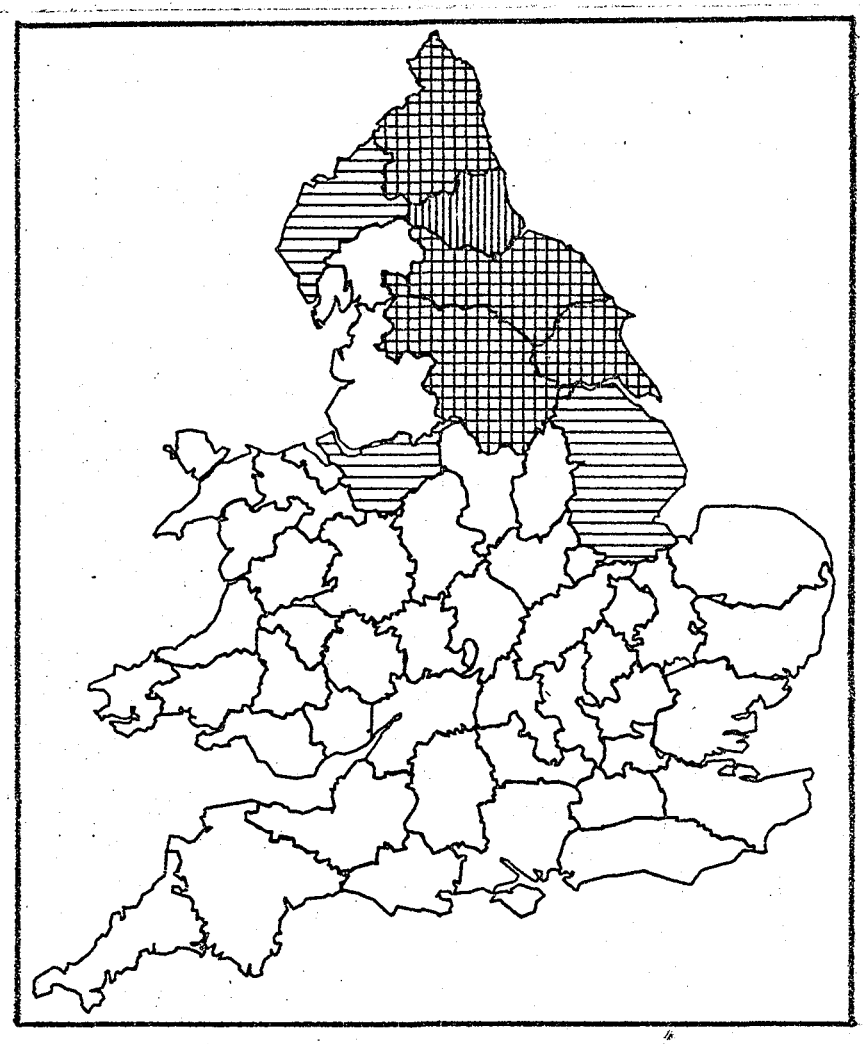
MAP 5.8: FREQUENCY DISTRIBUTION OF BIRTHPLACES OF MARINERS



MAP 5.9: FREQUENCY DISTRIBUTION OF AGRICULTURALIST'S BIRTHPLACES

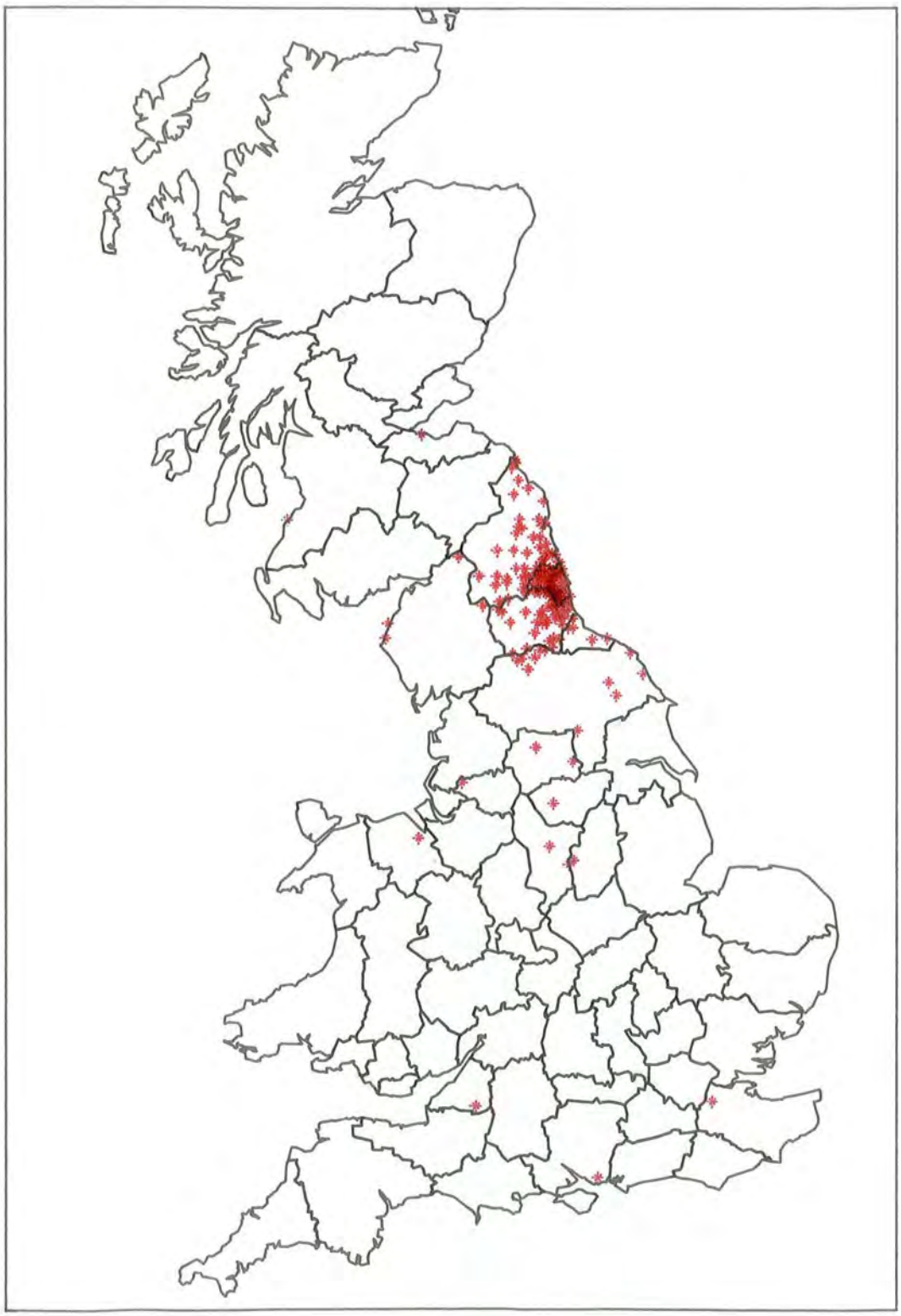


MAP 5.10: FREQUENCY DISTRIBUTION OF BIRTHPLACES OF MINERS

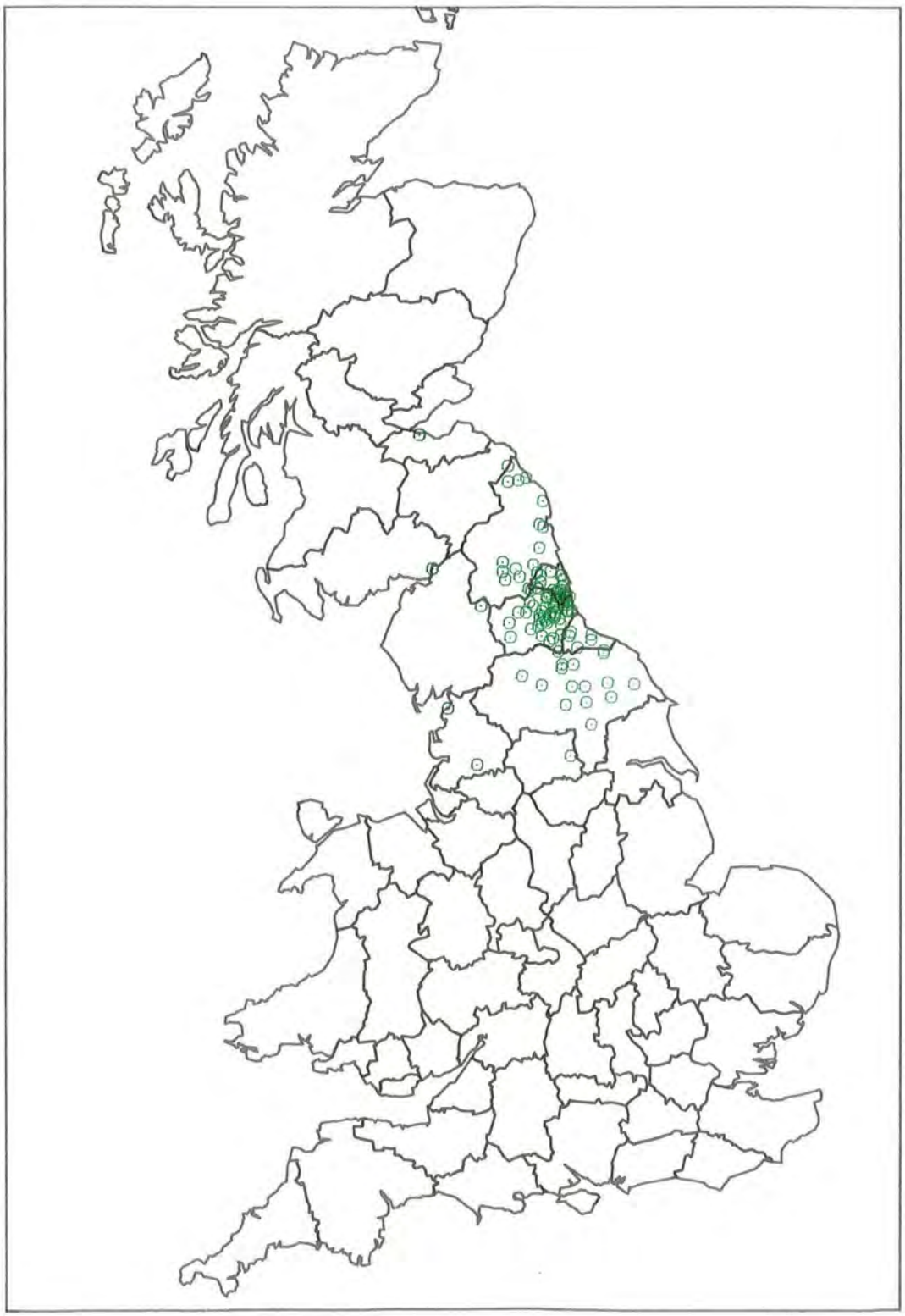


MAP 5.11: FREQUENCY DISTRIBUTION OF BIRTHPLACES OF PROFESSIONAL OCCS

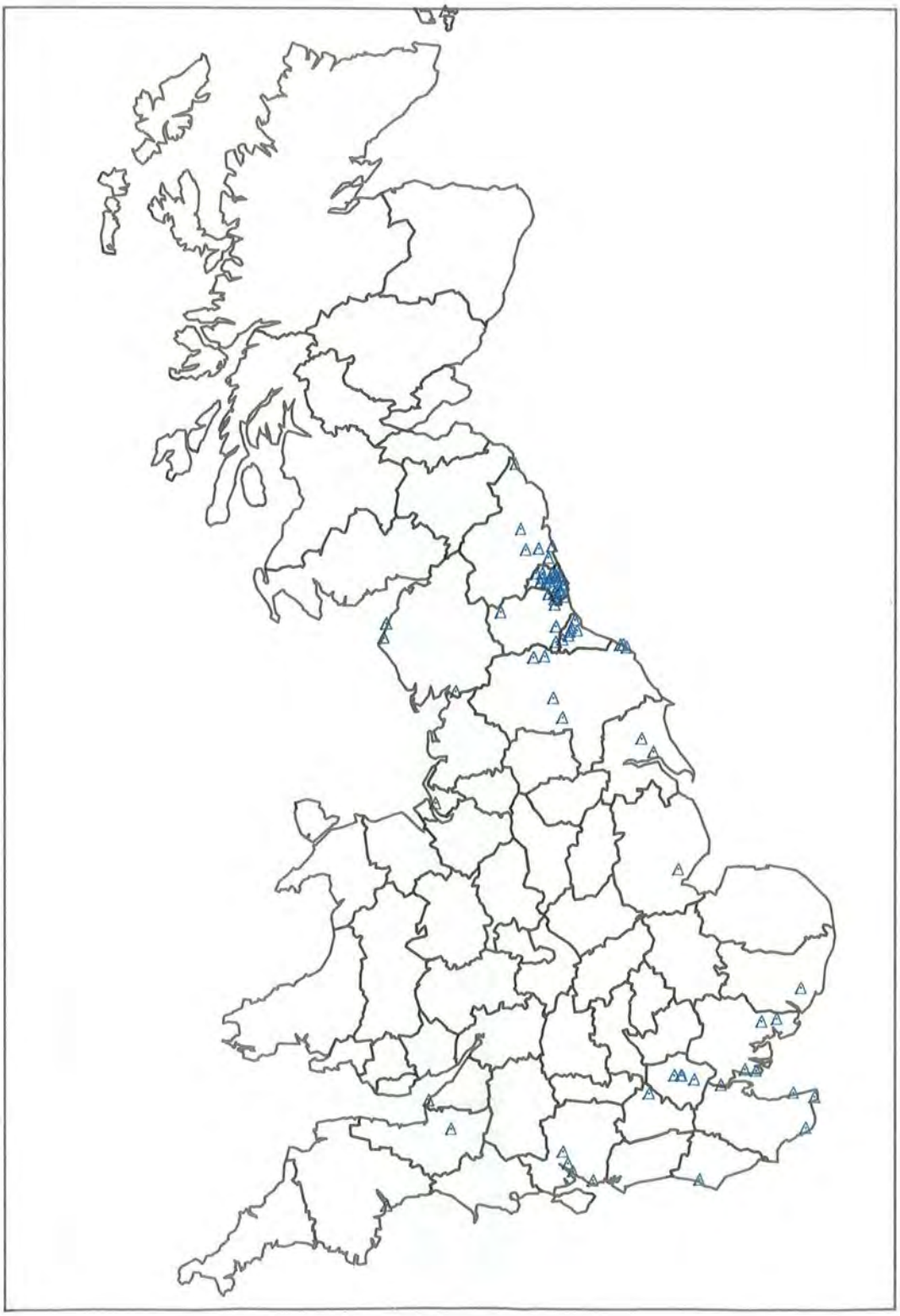
MAP 5.12: POINT DISTRIBUTION OF MINER'S BIRTHPLACES

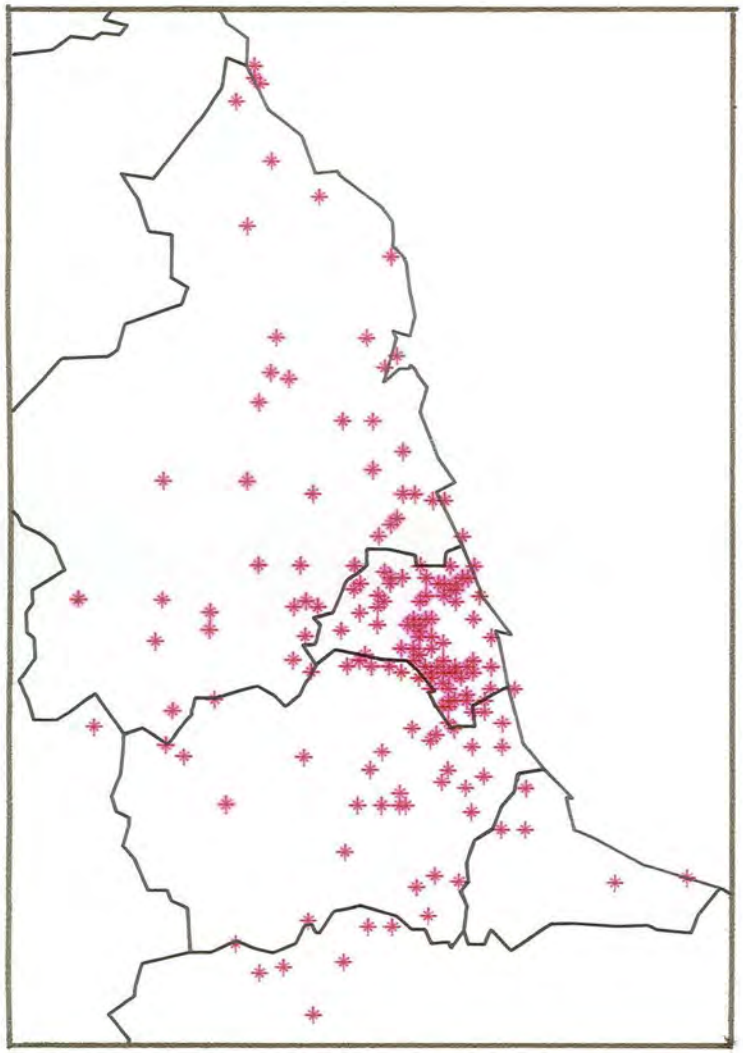


MAP 5.13: POINT DISTRIBUTION OF AGRICULTURALIST'S BIRTHPLACES

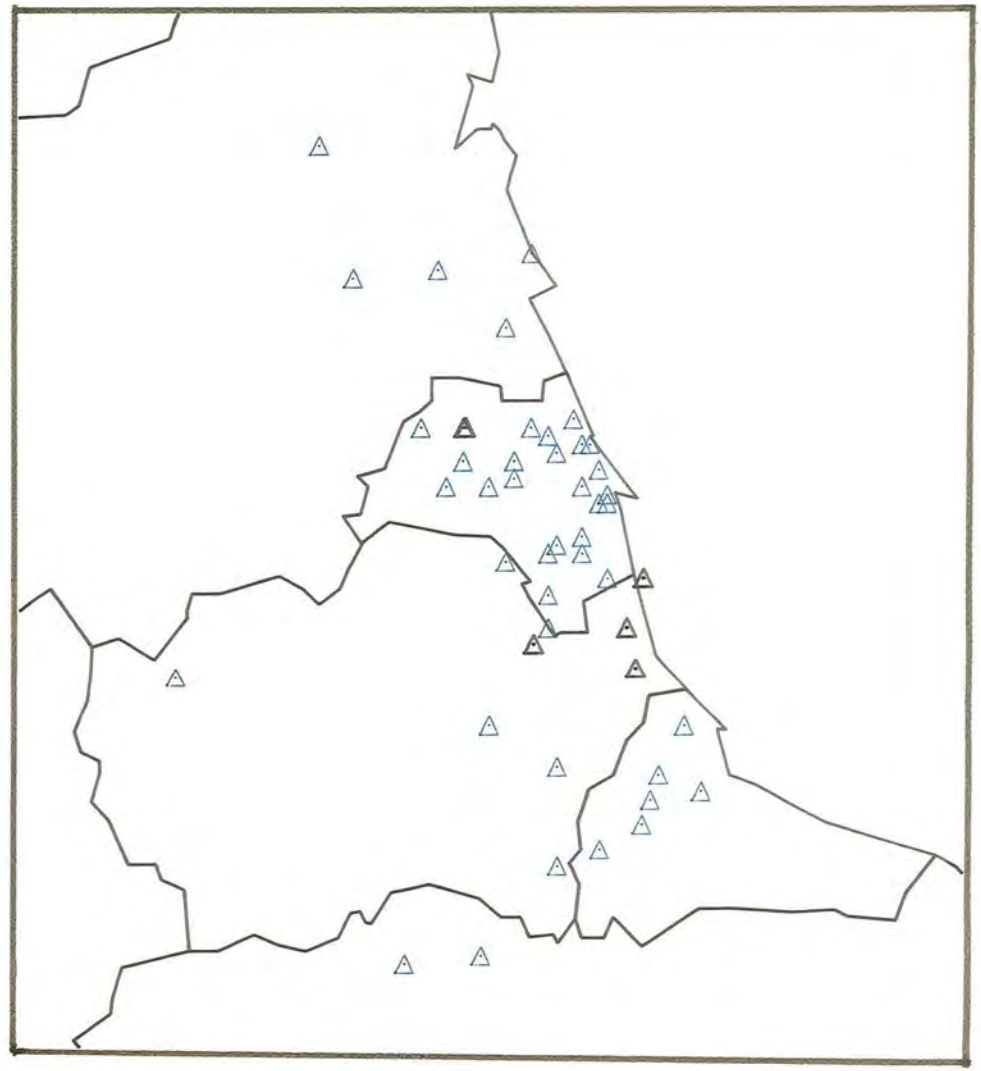


MAP 5.14: POINT DISTRIBUTION OF MARINER'S BIRTHPLACES

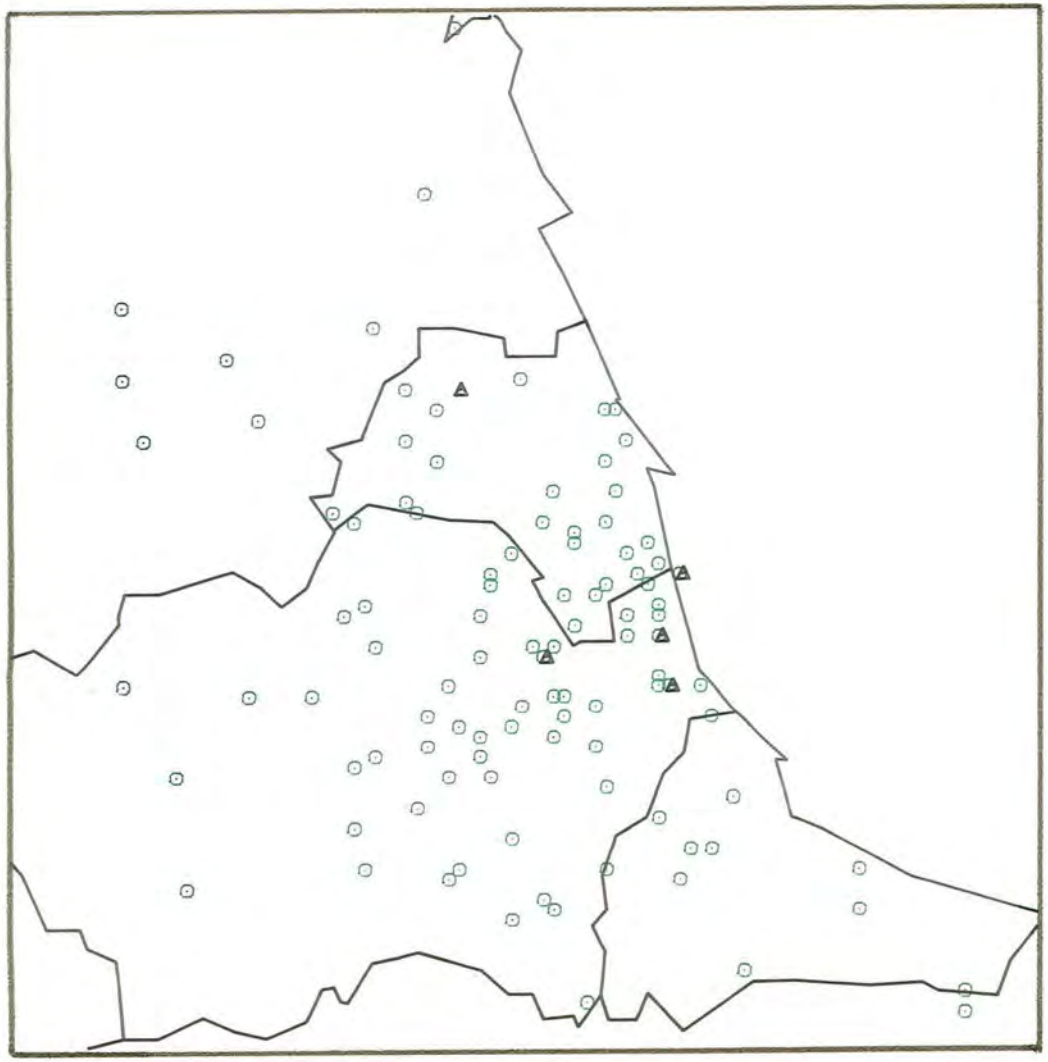




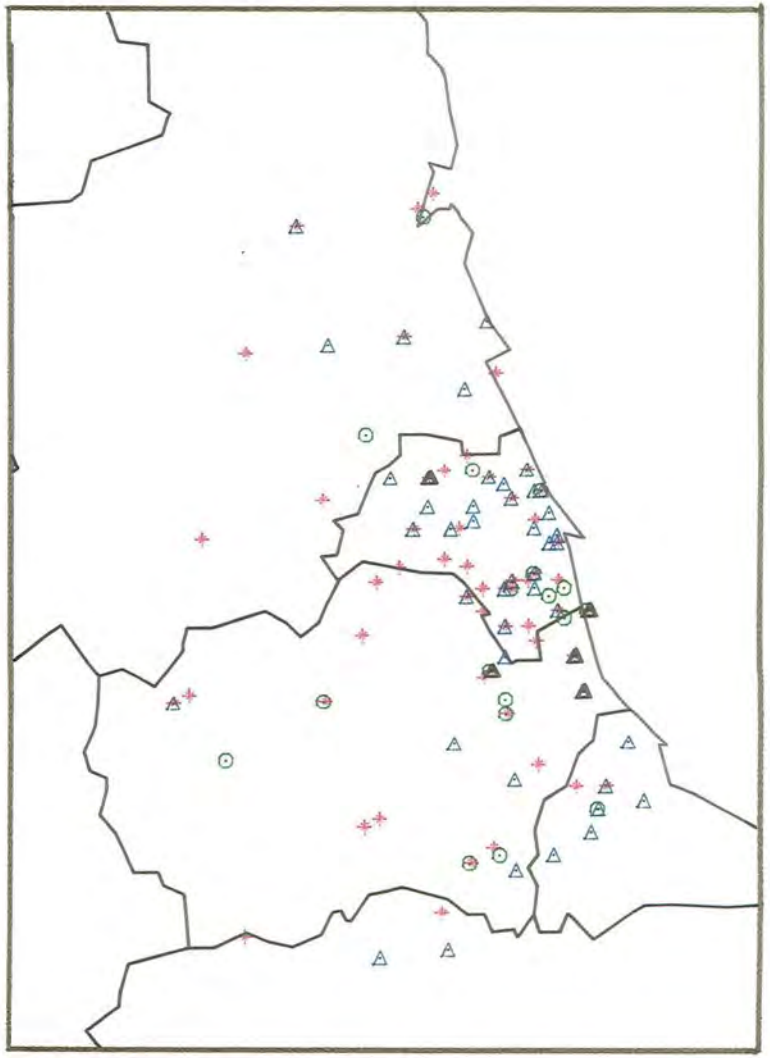
Map 5.15 Birthplaces of Miners: North-eastern Distribution



Map 5.16 Birthplaces of Seamen: North-East



Map 5.17: Birthplaces of Agriculturalists: North-Eastern Distribution



Map 5.18: Birthplaces of Seaham Harbour Residents: Stars=miners, circles= agrics triangles= mariners

the social classes which were also statistically significant. More members of Class II were born in Durham and Yorkshire than expected, probably because most farmers were categorised as Class II. Also master mariners would account for the higher number of this class from 'the rest of England and Wales'. Most pitmen were classified as Class IV and more of this group come from Northumberland. Notably, far more Irish were placed in Class V than expected conforming to the recognised tendency of these long-range migrants to initially fill the lower status posts.

Endogamy

We have seen the wide variety of birthplaces of migrants to the study area but are these migrants contributing to the gene pool of the whole population by marrying at random or was there a tendency to select a partner from the same area or county as oneself? Historical observations suggest that the Irish might form a distinct group in this way, principally because of their religion and language. They were concentrated around the railway in Seaham Harbour and were mainly employed in labouring at the brickworks and railway. Of the 144 adult Irish in the town (according to Sturgess. 1980), 58 were married and incorporated in this sample, the remaining were mainly young single males lodging with other Irish families. In the study area, the total number of marriages with at least one Irish-born partner was 48,

and in 66% of these both partners were born in Ireland. It cannot be determined whether this high value resulted from many marrying before coming to the study area or to conscious selection of Irish spouses after arriving here, without investigating the birthplaces of their children but it is by far the highest rate amongst migrants. Many more Scots had spouses from outside Scotland-mostly from Durham, Northumberland and Yorkshire- making the endogamy rate about a third of that of the Irish (23%) and migrants from Northumberland and Yorkshire showed county-endogamy rates of only 31% and 20% respectively.

Within the limits of the information available, it appears that there was some tendency for natives of the same counties to be married but it was only substantial amongst the Irish group. Whether this tendency continued at the level of township or parish is a different matter and this will be dealt with in the section on distance.

Migration Matrix Analysis

Although the numbers of men and women actually born in the study area were very small, migration matrix analysis was attempted. A matrix of individual's parish of birth (husbands and wives added together) against parish of residence in 1851 by was compiled, the natives of parishes outside the study area were

categorised as 'outside world'. Figures in a cell AB, for instance, represent the probability that a gene in B originated in A. Residence in 1851 is somewhat arbitrary, it represents a place to which individuals (and therefore their genes) move after birth but it may be one of many places and not one at the greatest distance from the birthplace. However, unlike matrices formed from parish register data in which it can only be assumed that the place of marriage is also the residence after marriage, matrices of census data use a known residence after marriage, and are therefore more accurate. A considerable proportion born in the study area must have moved out and would affect the outside world but as the flow inwards is markedly greater than outwards, this effect is probably very small. Results are shown in Tables 5.40-41.

If we consider migration between the four parishes only, the row proportions indicate Easington as the most 'endogamous' parish in that there is an 85% probability that individuals born in Easington will be living there in 1851 instead of the other three parishes. Dalton-le-Dale is the least 'endogamous' in this respect. However, as the number of generations to achieve 95% relatedness indicate, the difference between parishes are small. Dalton-le-Dale shares common ancestry with Easington and Seaham first, then Castle Eden but it is only a difference of one generation. There was little reciprocal exchange between Castle Eden and Seaham, yet it takes no longer for the two parishes to

Table 5.40. MIGRATION MATRIX: 1851 CENSUS, PARISHES ONLY

Birthplaces of individuals

Residence in 1851	DleD	Eas	Sea	C.E.	Tot
DleD	28	19	11	0	58
Eas	14	147	3	9	173
Sea	1	4	11	2	18
C.E.	0	7	1	18	26
Total	43	177	26	29	275

b) Migration expressed as a proportion of row total

	DleD	Eas	Sea	C.E.	Tot
DleD	0.4827	0.3276	0.1897	0	1.0
Eas	0.0809	0.8498	0.0173	0.0520	1.0
Sea	0.0556	0.2222	0.6111	0.1111	1.0
C.E.	0.0000	0.2692	0.0385	0.6923	1.0

c) Generations to homogeneity

DleD

6	Eas		
6	7	Sea	
7	7	7	C.E.

--oOo--

Table 5.41 MIGRATION MATRIX: 1851, PARISHES & OUTSIDE WORLD

Birthplace of individuals

Residence in 1851	DleD	Eas	Sea	C.E.	O.W.	Total
DleD	28	19	11	0	1554	1612
Eas	14	147	3	9	2095	2268
Sea	1	4	11	2	172	190
C.E.	0	7	1	18	124	150
Total	43	177	26	29	3945	4220

b) Migration expressed as a proportion of row total

	DleD	Eas	Sea	C.E.	O.W.	Total
DleD	0.0174	0.0118	0.0068	0.0	0.9640	1.0
Eas	0.0062	0.0648	0.0013	0.0040	0.9237	1.0
Sea	0.0053	0.0211	0.0579	0.0105	0.9052	1.0
C.E.	0.0	0.0467	0.0067	0.1200	0.8266	1.0
O.W.	0	0	0	0	1.0000	1.0

c) Generations to homogeneity

DleD				
2	Eas			
2	2	Sea		
2	2	2	C.E.	
1	2	2	2	O.W.

--oOo--

become related than for Castle Eden and Easington which exchanged many more. On the whole, time taken to reach homogeneity is much lower than that calculated from the parish data. Of course, this is an artificially closed system and when outside world immigration is included the time taken to reach homogeneity is markedly shorter. Migration from the outside world is greatest to Dalton-le-Dale and lowest to Castle Eden, which now becomes the most endogamous in terms of proportions of 1851 residents born there. This pattern causes Dalton-Le-Dale to become related to outside world first, a completely opposite result to that obtained from the parish data. If we compare these results with those obtained from similar analyses in modern Reading (Coleman, 1981) and the Isle of Wight (Smith, 1981) we see that genetic exchange was as great if not greater at this time in eastern Durham than today.

Unfortunately, the assumption that outside world is homogeneous is grossly inaccurate in this system. If subdivisions could have been utilised, a more detailed pattern could have been obtained but when this was attempted the same problem was encountered as in the parish analysis: none had become homogeneous even after 1000 generations. An attempt was made to incorporate the differentiation of the outside world by considering the effect of each subdivision in turn, the results are in Table 5.42. When migration from 'nearby' (Sunderland, Houghton-Le-Spring, Monk Heseldon, Pittington, Wingate, Kelloe,

Table 5.42 MATRIX ANALYSIS: GENERATIONS TO HOMOGENEITY

a) Four parishes and nearby

D-le-D

3				Easington
3	3			Seaham
4	4	4		Castle Eden
2	3	4	4	Nearby

b) Northumberland

D-le-D

2				Easington
3	3			Seaham
5	5	5		C.E.
2	3	3	5	Northumb.

c) Four parishes and the rest of Durham

D-leD

2				Easington
2	2			Seaham
2	2	2		Castle Eden
2	2	2	3	Rest of Durham

d) Four parishes and Yorkshire

D-le-D

5				Easington
7	6			Seaham
6	4	5		Castle Eden
5	6	8	7	Yorkshire

e) Rest of E, W, Scot, Ire

D-le-D

5				Easington
5	3			Seaham
6	5	5		C.E.
3	5	5	7	Rest of world

--oOo--

Bishop Wearmouth) was included, the shortest number of generations taken to reach homogeneity was between 'nearby' and Dalton-le-Dale and generations were generally longer than for the total outside world. When migration from Durham County (outside of the study area) was considered, Castle Eden was the slowest to become homogeneous with it. The effects of Northumberland and Yorkshire were very different.

It would have been interesting to have examined exchanges between townships but the numbers involved were so small that this was not practical. The matrices have produced some interesting results but they have proved inadequate when dealing with such large and varied migration.

Computation of Distance

Another way of examining the relationships between populations is to measure actual distances between birthplaces of partners and therefore obtain some idea of the movement of genes. As national grid references could be found for the majority of places mentioned in the Enumerator's schedules, three distances (in kilometres) were calculated:

1. The distance between birthplaces of marital partners

2. The distance between the man's birthplace and his last known residence (in 1851) -'husband's migration distance'

3. Similarly, the wife's migration distance

Not all the coded census data contained the necessary precise details on town of birth and some places could not be found in the directories of the period, but in nearly 80% of cases a birthplace distance could be computed and proportions for the migration distances were even higher. Because intra-town distances could not be measured, in cases where partners gave the same place-name the distance was zero, which could be used to measure the town endogamy rate. Likewise, occasionally the birthplace of an individual was the same as his residence and a rate of sedentism could be calculated. Such zero values are not real and cannot be included in a statistical analysis of distribution thus means, medians etc were tabulated for exogamous or non-sedentary cases only (Tables 5.43-47).

All birthplace distances are positively skewed i.e. more values appear at the lower distances but seamen, professional/clerical and Class I groups are the closest to being normally distributed and the mariner stratum is the only one to be slightly flat-topped as opposed to being peaked. The high degree of skew in the data make median values valuable additions to the means for comparative purposes. Both means and medians

indicate a clear trend for diminishing birthplace distance with social class which concords with modern observations (Coleman, 1981) of increased mobility in the professional and other non-manual groups. Assortative mating for class might be a causative factor, as the more numerous lower classes would not need to travel as far to find a suitable mate. However, unlike Coleman, there was no pattern between class and endogamy.

A more complicated pattern is produced by the medians and means of the occupational groups. The mariners have, by far, the highest endogamy rate but the exogamous cases show the greatest mean and second highest median (only beaten by the professional group). This is probably the result of the large distances mariners moved; perhaps those who married before coming to Seaham Harbour married in their home towns while most of the others married locally. It could also reflect the fact that mariners came from large towns such as Newcastle and Sunderland, in which case higher endogamy would be more likely. The large discrepancy between the mean and median of the mariner group emphasises the significant contribution of the longer birthplace distances but suggests that most birthplaces were only a little further apart than those of other occupational groups. Birthplace endogamy was also fairly high in the crafts group and again means and medians are high in the exogamous cases. Miners and labourers appear to have the smallest birthplace distances, when comparing both means and medians. F-Tests confirmed the significance of the means of

occupations and social classes (respectively: $F=27.5$, $p<.01$; $F=6.1$, $p<.01$).

When divided by residence the figures reflect the economic nature of the townships but there is some notable variation in endogamy rates between the rural villages of Castle Eden and Easington, which are of a similar population size. However distances in the exogamous cases are similar.

Remarkably, only 15% of partners were born in the same town which highlights the mobile nature of the populace, particularly when this figure is compared with the value of 51% found by Coleman (1977) using modern data. Further, the mean and median distances were considerably greater than six miles (approx. 10km) which was the basis for the neighbourhood model devised by Boyce et al (1967).

Examination of the migration distance distributions presents some notable variation. It is not fair to compare sedentism between colliery districts and the villages because of the comparative youth of the former (it follows that comparisons between occupational strata are also not very meaningful) but there is high variability within the rural population, and as commented on before, mobility is higher than might have been expected. Only 14% of of all village residents were born there and men (16%) were more sedentary than women (13%) repectively.

Table 5.43 CENSUS 1851: BIRTHPLACE DISTANCE (KM)

			Exogamous cases						
Category	N	Endog%	N	Range	Mean	S.D±	Med.	Skew	Kurt
All	1677	15	1432	1.0-534	40.6	72.4	17.7	4.1	17.7
Occupation									
Miner	797	13	693	1.0-453	28.6	41.2	15.1	4.5	29.2
Seaman	162	30	113	2.0-534	123.0	165.2	30.0	1.2	-0.4
Agric	198	12	174	1.0-413	34.4	48.0	22.6	5.5	37.8
Shopks	79	9	72	2.0-406	47.6	73.6	22.1	3.3	11.7
Indust	140	9	128	3.0-432	45.4	85.5	17.2	3.3	10.4
Crafts	202	19	164	1.0-453	40.0	65.4	20.4	4.3	21.5
Prof/Cler	30	13	26	3.6-175	51.6	48.6	32.8	1.3	0.9
Labourer	59	8	54	1.4-155	28.6	28.9	18.0	2.5	7.0
Social Class									
Class I	8	13	7	12.7-393	120.6	127.9	80.6	1.6	1.2
Class II	235	17	196	2.0-534	58.1	104.7	22.6	3.0	8.4
Class III	297	18	244	1.0-453	42.1	71.0	19.0	3.8	15.7
Class IV	1048	13	907	1.0-466	36.7	65.1	16.2	4.3	20.3
Class V	80	11	71	1.4-155	30.7	30.7	22.1	2.3	5.8
Residence									
Castle Eden P.	62	10	56	3.0-388	39.6	58.0	22.0	4.2	21.6
Easington V.	73	23	56	2.0-407	33.3	57.6	22.0	5.2	30.3
Seaton	23	9	21	2.2-109	30.7	25.3	24.4	2.0	3.5
Murton Coll.	134	10	120	1.0-221	29.9	42.1	13.4	3.1	9.5
S. Hetton Coll	295	10	266	1.4-369	27.2	35.2	15.6	4.8	35.5
Shotton Coll.	180	14	155	1.4-359	33.5	49.6	16.6	4.0	19.8
Seaham Harbour	435	20	348	1.0-534	74.8	122.3	23.0	2.2	3.6

Table 5.44 CENSUS 1851: WIFE'S MIGRATION DISTANCE (KM)

Category	N	Sedent%	Non-sedentary cases N	Range	Mean	S.D.±	Med.	Skew	Kurt
All	1851	3	1795	1.0-532	33.1	54.0	20.0	5.2	31.9
Husband'S Occupation									
Miner	867	0.6	862	2.0-389	27.7	33.0	21.4	5.3	41.8
Seaman	186	0.5	185	2.2-532	46.1	97.4	16.2	3.4	10.7
Agric	222	8	204	1.0-408	32.1	45.6	20.3	5.6	39.6
Shopks	89	2	87	2.2-391	38.5	57.8	22.2	4.2	20.7
Indust	155	4	149	2.2-397	40.1	75.1	19.9	3.8	14.1
Crafts	218	9	199	1.4-448	39.8	66.3	20.0	4.3	20.3
Prof/Cler	35	3	34	6.0-320	51.6	66.7	23.4	2.5	6.6
Labourer	68	4	65	2.0-87.	25.5	19.1	22.8	1.2	1.1
Husband's Social Class									
Class I	9	0	9	7.2-211	72.8	78.3	30.6	0.8	-1.0
Class II	250	4	240	1.0-532	37.6	71.1	17.1	4.8	24.7
Class III	336	5	310	1.4-448	38.2	64.3	20.0	4.3	20.7
Class IV	1165	2	1140	1.4-449	30.8	47.6	20.6	5.5	35.8
Class V	91	4	87	2.0-170	30.0	27.8	23.2	2.5	8.2
Residence									
Castle Eden P.	67	12	59	3.0-388	40.1	58.0	21.0	4.1	20.6
Easington V.	80	33	54	1.4-442	33.6	62.1	17.1	5.5	33.0
Seaton	25	8	23	2.2-56.9	24.9	17.4	16.1	0.5	-1.2
Murton Coll.	-	-	154	1.4-201	23.1	25.8	18.1	4.2	21.5
S. Hetton Coll	-	-	320	2.0-389	30.0	40.5	21.6	5.1	34.2
Shotton Coll.	-	-	196	3.2-371	37.4	43.3	27.7	4.5	27.4
Seaham Harbour	-	-	479	2.2-532	44.7	83.8	17.1	3.7	13.1

Table 5.45 CENSUS 1851: HUSBAND'S MIGRATION DISTANCE (KM)

Category	N	Sedent%	Non-sedentary cases N	Range	Mean	S.D.±	Med.	Skew	Kurt
All	1824	4	1759	1.0-490	37.7	63.4	21.9	4.6	23.8
Occupation									
Miner	857	0.3	855	1.0-448	30.2	37.9	22.4	5.3	40.6
Seaman	175	0	175	4.0-490	88.2	143.8	17.1	1.7	1.3
Agric	220	13	191	1.4-173	30.3	29.7	20.8	2.0	4.4
Shopk	86	5	82	2.0-418	49.0	76.2	25.1	3.4	11.5
Indust	149	2	146	2.0-448	28.6	43.1	20.1	7.1	61.8
Crafts	224	9	204	1.0-379	30.5	44.8	16.1	5.0	33.2
Prof/Cler	34	0	34	1.4-450	65.5	92.0	28.3	2.6	7.4
Labourer	68	9	62	2.0-168	36.9	34.5	26.4	1.9	3.9
Social Class									
Class I	9	0	9	8.6-379	125.3	123.9	86.7	0.9	-0.2
Class II	258	6	242	1.0-490	45.3	85.7	18.0	3.8	14.1
Class III	330	5	312	1.0-449	32.6	53.0	16.6	4.7	26.9
Class IV	1127	2	1103	1.0-461	36.6	60.1	22.4	4.9	26.5
Class V	90	7	84	2.0-379	41.0	50.6	26.9	4.1	22.5
Residence									
Castle Eden P.	68	15	58	1.0-122	31.1	31.0	19.0	1.8	2.1
Easington V.	79	35	51	1.4-103	27.8	27.5	20.8	1.5	1.1
Seaton	28	14	24	4.1-109	26.7	22.0	23.0	2.3	6.4
Murton Coll.	-	-	153	1.0-204	25.6	35.2	17.5	3.7	14.3
S.Hetton Coll.	-	-	317	2.0-394	27.7	35.0	22.0	5.5	43.4
Shotton Coll.	-	-	190	4.5-396	39.7	41.6	28.3	4.3	28.6
Seaham Harbour	-	-	466	2.2-490	59.7	105.2	20.6	2.8	6.7

Table 5.46 SEAHAM HARBOUR 1851: BIRTHPLACE AND MIGRATION DISTANCES

a) Birthplace Distance

Occupation	N	Endog%	N	Range	Mean	S.D.±	Med.	Skew	Kurt
Miner	83	11	74	1.0-453	34.5	55.5	21.1	6.0	42.1
Seaman	161	30	112	2.0-534	124.1	165.6	30.0	1.1	-0.4
Agric	21	14	18	1.0-91.0	32.6	26.1	20.0	0.8	-0.4

b) Husband's Migration Distance

Occupation	N	Sedent%	N	Range	Mean	S.D.±	Med.	Skew	Kurt
Miner	87	1	86	4.0-448	32.6	50.3	22.1	6.7	52.2
Seaman	174	0	174	4.0-490	88.6	144.1	17.1	1.7	1.2
Agric	23	9	21	3.2-148	36.1	39.0	24.2	1.8	2.4

c) Wife's Migration Distance

Husband's Occupation	Sedent%	N	Range	Mean	S.D.±	Med.	Skew	Kurt
Miner	87	2	85	5.3-98.4	24.3	20.0	17.1	1.9	3.7
Seaman	185	0.5	184	2.2-532	46.1	97.7	16.1	3.4	10.6
Agric	27	4	26	4.2-191	33.6	39.1	20.3	2.9	8.5

Table 5.47 1851 CENSUS: SOME DISTRIBUTIONS OF DISTANCES (%)

Distance (km)	BP Dist Miner	Mighus Miner	BP Agric	BP Mariner	BP Prof	Migwif All	Mighus All	BP All
1.0-25.9	70.0	65.1	57.5	49.6	38.5	65.4	62.8	63.4
26.0- 50.9	16.7	23.4	27.6	11.5	26.9	21.7	21.8	19.1
51.0- 75.9	5.8	5.3	9.2	6.2	7.7	5.3	6.5	6.7
76.0-100.9	2.2	1.2	2.9	1.8	15.4	2.5	1.8	2.9
101.0-125.9	1.0	1.9	1.1	1.8		1.3	2.3	1.3
126.0-150.9	1.9	1.6	0.6	1.8	3.8	1.1	1.5	1.6
151.0-175.9	1.0	0.4		2.7	7.7	0.5	0.3	1.1
176.0-200.9	0.6	0.2		0.9		0.2	0.2	0.3
201.0-225.9	0.4	0.6	0.6			0.2	0.5	0.4
226.0-250.9				0.9			0.1	0.1
251.0-275.9								0.1
276.0-300.9							0.1	0.1
301.0-325.9						0.3	0.1	
326.0-350.9	0.1			1.8		0.1		0.3
351.0-375.9	0.1			0.9		0.2	0.2	0.3
376.0-400.9		0.2	0.6	9.7		0.7	0.9	1.0
401.0-425.9				2.7			0.2	0.4
426.0-450.9		0.1		3.5		0.3	0.6	0.3
451.0-475.9	0.1			2.7			0.1	0.3
476.0-500.9				0.9			0.1	0.1
501.0-525.9								
526.0-550.9				0.9		0.1		0.1
Total	100%	100%	100%	100%		100%	100%	100%

--oOo--

Short-range movement is the prominent feature of the traditional occupational groups and this is highlighted by low maximum distances, small means and medians. Figures 5.27 and 5.28 emphatically demonstrate the great differences in the distribution of men's migration distances between seamen and agriculturalists. There is also a rough trend for decreasing migration distance from Class I to Class V for both men and women which is significant at the 1% and 2% level of significance respectively.

Patterns of movement exhibited by the occupation groups are complex. Many more seamen came from very long distances but the heavy immigration from the nearby ports of Sunderland and South Shields make the median value one of the lowest. Although a few miners moved large distances from Kent and Devon, their means and medians are very similar to those of the agricultural group. The professional group travels far, while the shopkeepers and industrial employees show intermediate distances. Most of these remarks apply to the wife's migration distance aswell, but the movement of women is over a shorter distance on average.

Of course, these migration distances are not necessarily the greatest distances moved by an individual in his or her lifetime and it might be expected that they would be dependent on age. However, there was no significant correlation between age and migration distance, and mean distances calculated for three age

FIGURE 5.27

MALE MIGRATION DISTANCE: AGRICULTURALISTS (N=191)

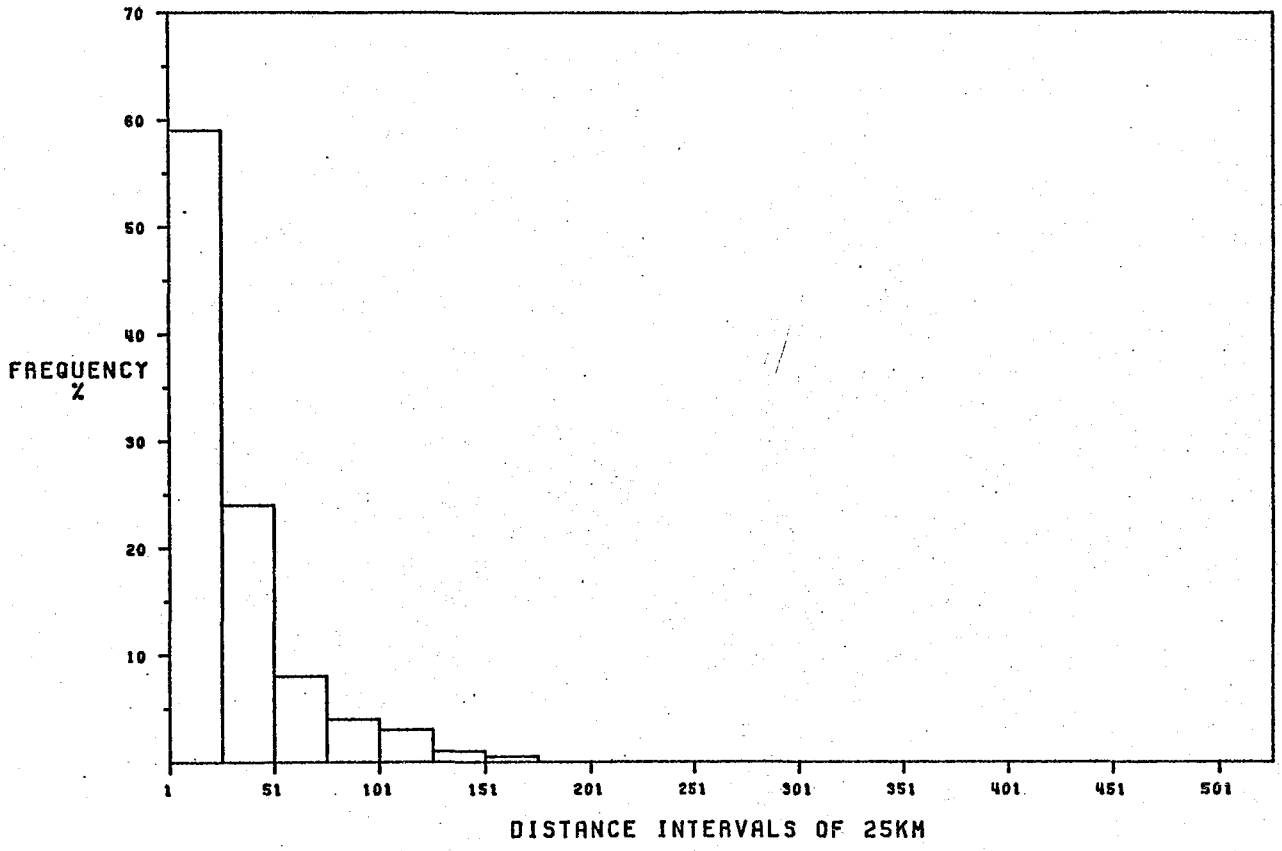
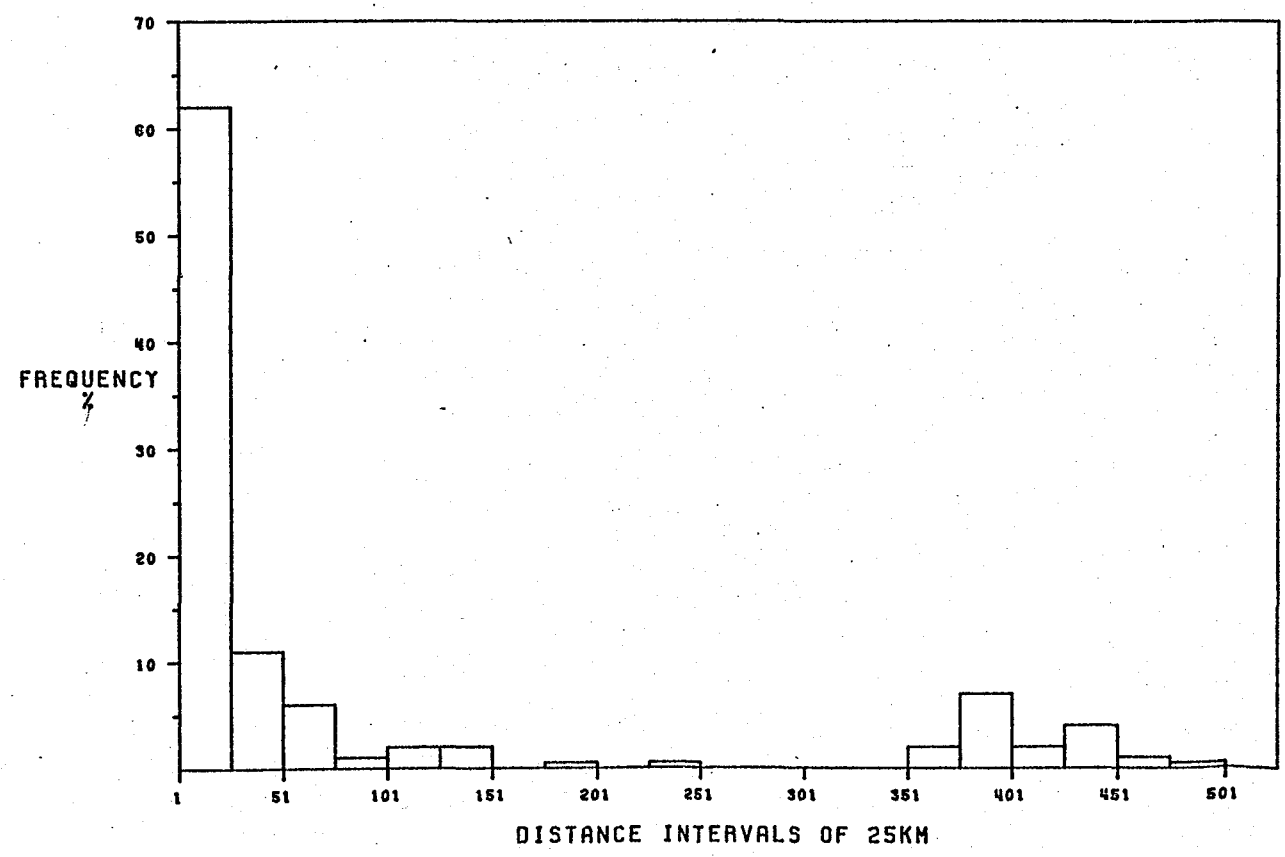


FIGURE 5.28

MALE MIGRATION DISTANCE: SEAMEN (N=175)



groups (18-28, 29-58 & 59-84) were not significantly different for men or women. On the other hand, an F-Test showed that differences between mean birthplace distances in the three age-groups were very significant and a trend for increasing birthplace distance with lower age-group was determined:

Table 5.48 Birthplace Distance and Age

Male Age	N	Mean Dist	Female Age	N	Mean Dist
19-38	688	45.83	18-38	804	44.61
39-58	614	35.83	39-58	530	35.63
59-83	129	35.72	59-84	96	34.23
F=3.4 p=0.03			F=2.9 p=0.06		

These figures have given some idea of the differing distributions of distances but they cannot reflect the great frequency of movement, particularly in the mining group. Judging by the variety of birthplaces exhibited by the children of a typical mining family, movement is largely over short distances but is very frequent and this circularity of movement is lost if net migration is considered alone. Nevertheless, some important differences have been brought to light and it should be particularly noted that birth-town endogamy in the mining group

was lower than the average at this period, contrary to contemporary observations.

Fertility

As data on children had been collected, a small amount of unsophisticated analysis of fertility was undertaken. No attempt was made to calculate age-specific fertility or to standardise the data in any way and all children were included in the analysis whatever their age. The following distribution of numbers of children in each family was obtained:

Table 5.49 Family Size

No. child.	0	1	2	3	4	5
No. families	361	384	340	303	249	223
%	17.1	18.1	16.1	14.3	11.8	10.5
No. child.	6	7	8	9	10	
No. families	127	80	33	14	2	
%	6.0	3.8	1.6	0.7	0.1	

Table 5.50 FERTILITY IN THE STUDY AREA

Category	Number	Range	Mean	St.De.
Total	2116	0-10	2.75	±2.17
Occupation				
Miner	974	0-10	2.91	±2.20
Crafts	254	0-9	2.80	±2.28
Agricultural	263	0-10	2.77	±2.24
Labourer	83	0-9	2.75	±1.85
Industrial	177	0-9	2.72	±2.08
Shopkeepers	99	0-9	2.70	±2.06
Professional	42	0-7	2.52	±1.86
Mariner	212	0-9	2.06	±2.01
Social Class				
Class IV	1319	0-10	2.80	±2.16
Class III	376	0-9	2.75	±2.21
Class II	284	0-9	2.65	±2.27
Class V	115	0-9	2.50	±1.93
Class I	11	0-7	2.36	±2.29
Husband's Birthplace				
Co. Durham	1267	0-10	2.80	±2.22
Northumberland	491	0-9	2.76	±2.13
Yorkshire	128	0-9	2.79	±2.28
Other No Cos	45	0-6	2.09	±1.88
Scotland	56	0-9	2.50	±1.98
Ireland	39	0-7	2.79	±1.99
Rest E & W	78	0-8	2.37	±1.93

--oOo--

In Table 5.50 the mean number of children per family may be compared across occupational, social class and birthplace strata. When using Census data, the number of children present on the night of the enumeration is taken as the measurement of fertility. No information is provided on the total number of surviving children each mother had nor the total number she had given birth to, so the measurement is not absolute; but unless there were major differences in other factors that would affect this number, for instance, age of leaving home or mother's age, this value is useful as an indication of relative fertility. Differential fertility, as defined above, is evident between the occupation groups, miners achieving the highest rate and mariners the lowest. The three 'rural' occupation groups follow closely behind the miners. Fertility decreases as we go from Class IV to Class I but Class V exhibits low fertility. An F-Test confirmed the significance of the occupation differences (at the 2% level) but class means were not statistically significant. A further test revealed that the higher mean number of children per family in the mining group (2.9) compared to all other occupation groups (2.6) was also very significant. this time at the 1% level.

An inspection of age in these occupation groups (by husbands occupation) showed that women married to miners had the highest mean age and those married to agriculturalists the lowest, suggesting that on this simple level of analysis, age discrepancies are not biasing the calculation of fertility. The

group with the lowest fertility (the mariners) was only a little older on average than the mining group. Birthplace of parents is also, to a small extent, associated with differing fertility levels: mean number of children per family was notably lower when the father was born in Scotland, or parts of England and Wales other than Durham, Northumberland and Yorkshire. But this may simply be the effect of low fertility amongst mariners again, as so many of the group were born in the south. Irish families were only a little smaller than those of County Durham.

LINKAGE: 1851 CENSUS AND PARISH REGISTER

Finally, in order to investigate the extent to which the parish register information on origin as opposed to 'birthplace' would underestimate exogamy, and thus distort the patterns of relatedness between populations. a small sample was linked between register and 1851 Census. This proved to be a time-consuming and laborious task because so few couples could be traced, therefore a complete linkage was not attempted. Further, linkage was only attempted between the parish register and enumerator's schedules for each particular parish separately, cross-links within the study area were not looked for.

Eighty-two couples were found in this way and analysed for discrepancies between their birthplaces and and place-name given at the time of marriage. This information, the date of marriage and husband's occupation are tabulated in 5.51 at the end of this chapter. Because of the high mobility of the population, the sample was biased mainly to marriages occurring shortly before 1851 where a difference between birthplace and the specified 'residence before marriage' would be very likely but the few earlier marriages in the sample also showed many discrepancies. For instance, in the parish of Seaham. of the six individuals marrying before 1837 only two were born in the same parish as given in the Marriage register. However, the majority of cases which specified the same place did occur in the early period: 44%

compared to only 7% between 1837 and 1851, which could indicate either that the settlement information actually was birthplace or that movement was less common between birth and marriage in the early period. During the early period, Castle Eden scored higher than any other for matching data 50%; the rate in Easington was 44%, in Dalton-le-Dale 43% and in Seaham 33%.

In the matrix analyses of the previous sections, the observed rates of migratin into the parishes provided the basis for calculating the genetical relatedness between populations but the linked sample shows that immigration and exogamy rates would be grossly underestimated utilising parish data. According to birthplace data the rate of migration into Seaham would have been 60%, but only 10% according to residence data. Likewise, the respective rates for Dalton-le-Dale would have been 93% and 4%; for Easington, 64% and 3%; and for Castle Eden, 79% and 50%. These are remarkably large discrepancies.

We have also considered the birthplace distance between married partners and the endogamy rate in terms of the proportion of marriages in which partners came from the same parish or town. As township was never specified in the early period it would be best to examine parish endogamy. The birthplace endogamy rate for the four parishes, where a parish was named, was only 16% but according to residence data this value was as high as 69%. However, the discrepancy is not always systematic, one marriage

(number 22 of Dalton-le-Dale) would have been counted as town-exogamous in the parish register but it was in fact town-endogamous by birthplace! Usually, though endogamy is overestimated in the parish registers both pre and post-1837.

As National Grid References could be found for a substantial proportion of the sample, birthplace distances for the exogamous cases were compared for marriages occurring in the early and late periods (in this case the late period is 1837-1851). Unfortunately the sample was too small for a statistical test on the mean differences to be meaningful but the means were very different: 16.76 and 64.16 respectively. Secondly, birthplace distances were also notably higher in the lower 'age at marriage' group, 60.0km for groom's age at marriage of 16-25, and 42.1km for age 26-48. Again, the sample was not large enough for a statistical test to be performed. Upon examining the age at marriage for the early and late periods, the second observation appears to be related to the first. As age was not asked for before 1837, it was calculated from the age given in the Census and the date of marriage. Assuming that the inhabitants gave their correct age in 1851, age at marriage was significantly higher (at the 1% level) for both bride and groom when they married before 1837: groom's age=29.2, bride's age=26.0 compared with 24.6 and 22.3 in 1837-1851. This result concords well with the evidence in the Easington register of decreasing age at marriage from 1837 to 1876.

Table 5.51 LINKED COUPLES: CENSUS AND PARISH REGISTER

a) Marriages in Seaham Parish

	Birthplace	Residence before Marriage	Date	1851 Residence
1)	Seaton, Durham Croft, Yorks	Seaham Parish Seaham P.	1820	Seaton T. Farmer
2)	Seaton, Durham W. Boldon, Durham	Seaham Parish Seaham P.	1826	Seaton T. Agric Labourer
3)	W. Rainton, Dur Burdon, Dur	Seaham Parish Seaham Parish	1833	Seaton Bank Rail Labourer
4)	Seaham, Dur Dalton-le-D., Dur	Seaham Parish Dalton-le-D. P.	1844	Seaham Bank Mill Miller
5)	Seaton, Dur Hulam, Dur	Seaton Seaton	1842	Seaton T. Agric Labourer

b) Marriages in Dalton-le-Dale Parish

1)	Hetton, Dur Unknown, Durham	Murton Moor Murton Moor	1842	Murton Moor Farmer
2)	Kellow, Dur Kellow, Dur	D-le-D Parish D-le-D Parish	1835	Murton W. Moor Farmer
3)	Evenwood, Dur Lawfields, Dur	D-le-D. Parish D-le-D Parish	1830	East Murton Blacksmith
4)	Dalton-le-D, Dur East Murton, Dur	D-le-D Parish D-le-D Parish	1817	East Murton Farmer
5)	Northumberland Co. Dalton, Durham	Murton Coll. Murton Coll.	1847	Murton Coll. Shoemaker
6)	Jarrow, Dur Cornforth, Dur	Murton Murton	1841	Murton Coll. Grocer
7)	Gateshead, Dur Tanfield, Dur	Murton Coll. Murton Coll.	1843	Murton Coll. Coalminer
8)	Chester-le-St, D. Houghton-le-Sp, D.	Seaham Harbour Seaham Harbour	1845	Murton Coll. Miner
9)	Eastwood, Notts Howdenfield, North	Seaham Harbour " "	1845	Murton Coll. Miner

Table 5.51 cont. Dalton-le-Dale Marriages

	Birthplace	Residence before Marriage	Date	1851 Residence & Occupation
10)	Blythe, North Newton, Yorks	Murton Coll. Cold Heseldon	1850	Murton Coll. Miner
11)	Embleton, North Wallsend, North	Murton Coll. Murton Coll.	1847	Murton Coll. Miner
12)	Eastwood, Notts Percy Main, North	Murton Coll. Murton Coll.	1847	Murton Coll. Miner
13)	Easington, Dur Lawton, Yorks	Fatten Pasture Fatten Pasture	1849	Murton Coll. Miner
14)	W. Rainton, Dur Willington, North	Murton Coll. Murton Coll.	1847	Murton Coll. Miner
15)	Hetton, Dur Eighton Banks, D.	Murton Coll. Murton Coll.	1847	Murton Coll. Miner
16)	Rothbury, North Durham Co.	Rothbury, North D-le-D. Parish	1832	Dalton-le-D V. Colliery joiner
17)	Scotland Scotland	Seaham Harbour Seaham Harbour	1839	Seaham Harbour Seaman
18)	Workington, Cumb North Shields, N.	Newcastle Seaham Harbour	1847	Seaham Harbour Ship's broker
19)	S. Shields, Dur Sunderland, Dur	Seaham Harbour Seaham Harbour	1839	Seaham Harbour Mariner
20)	Westminster, Middx. Gosforth, Cumb.	Seaham Harbour Seaham Harbour	1848	Seaham Harbour Mariner
21)	Pensher, Dur Hull, Yorks	Seaham Harbour Seaham Harbour	1846	Seaham Harbour Master Mariner
22)	Gateshead, Dur Gateshead, Dur	Seaham Harbour Murton Coll.	1840	Seaham Harbour Mariner
23)	Sunderland, Dur Sunderland, Dur	Seaham Harbour Seaham Harbour	1846	Seaham Harbour Blacksmith
24)	Wallsend, North Sunderland, Dur	Seaham Harbour Seaham Harbour	1843	Seaham Harbour Fisherman
25)	Barnard Castle, D. Alston, Cumb	Seaham Harbour Seaham Harbour	1846	Seaham Harbour House joiner

Table 5.51 cont. Dalton-le-Dale Marriages

	Birthplace	Residence before Marriage	Date	1851 Residence & Occupation
26)	Cornforth, Dur Sunderland, Dur	Seaham Harbour Seaham Harbour	1846	Seaham Harbour Mason
27)	Hylson, Yorks Trimdon, Durham	Seaham Harbour Seaham Harbour	1844	Seaham Harbour Agric Labourer
28)	Jarrow, Dur Seaham Harbour	Seaham Harbour Seaham Harbour	1850	Rail Labourer Seaham Harbour
29)	Bromley, Essex Richmond, Yorks	Seaham Harbour Seaham Harbour	1847	Seaham Harbour Mariner

c) Marriages in Easington Parish

1)	Witton Gilbert, D. Witton Gilbert, D.	Easington P. Easington P.	1831	Easington V. Tailor
2)	Easington, Dur Easington, Dur	Easington P. Easington P.	1837	Easington V. Agric Labourer
3)	Barfieldsire, Dur Billy Row, Dur	Easington P. Easington P.	1832	Easington V. Butcher
4)	Willington, Dur Easington, Dur	Easington P. Easington P.	1833	Easington V. Agric Labourer
5)	Broadberg, Dur Easington, Dur	Easington P. Easington P.	1832	Easington V. Shoemaker
6)	Easington, Dur Birtley, Dur	Easington P. Easington P.	1828	Easington V. Agric Labourer
7)	Westoe, Dur Easington, Dur	Easington P. Easington P.	1831	Easington V. Farmer
8)	Hawthorne, Dur Haswell, Dur	Easington P. Easington P.	1819	Thorpe, Eas Shoemaker
9)	Woolley, Dur Easington, Dur	Easington P. Easington P.	1837	Hilltop V. Eas Pitman
10)	Heselton, Dur Finchale Abbey, D.	Monk Heselton P. Easington P.	1820	Little Thorpelea Farmer
11)	Hamsterly, Dur Pittington Hallgarth Durham	Easington P. Easington P.	1832	Beacon H. Eas Farmer

Table 5.51 cont. Easington Parish Marriages

	Birthplace	Residence before Marriage	Date	1851 Residence & Occupation
12)	Newton, Yorks Wooler, North	Easington P. Easington P.	1834	Easington Lea Farmer
13)	Witton Gilbert, D. Easington, Dur	Easington P. Easington P.	1830	Ling Close, Eas Farmer
14)	Thorp, Durham Thorp, Durham	Easington P. Easington P.	1836	Thorp Moor Mill Miller
15)	Easington, Dur Stockley, Dur	Easington P. Easington P.	1834	Cotsford Gr. Shot Farmer
16)	Mountain, Dur Chester-le-St, D.	Haswell Haswell	1840	Shotton Coll. Engineman
17)	Stanhope, Dur Ovingham, North	Easington P. Easington P.	1833	Shotton Coll. Miner
18)	Scotland Wallsend, North	Haswell Haswell	1848	Shotton Coll. Miner
19)	Flatfield, Dur Gateshead, Dur	Shotton Coll. Shotton Coll.	1846	Shotton Coll. Miner
20)	Long Benton, North Pensher, Durham	Shotton Coll. Shotton Coll.	1847	Shotton Coll. Miner
21)	Pensher, Dur Pensher, Dur	Shotton Coll. Shotton Coll.	1845	Shotton Coll. Miner
22)	Bp. Middleham, D. Easington, Dur	Shotton Coll. Easington V.	1844	Shotton Coll. Miner
23)	Herrington, Dur Rainton, Dur	S. Hetton S. Hetton	1850	S. Hetton Miner
24)	W. Auckland, Dur Brinkley, North	S. Hetton S. Hetton	1847	S. Hetton Brickmaker
25)	Houghton-le-Sp. D. Rainton, Dur	S. Hetton S. Hetton	1850	S. Hetton Joiner
26)	Jarrow, Dur Eldon, Dur	Hartlepool S. Hetton	1847	S. Hetton Blacksmith
27)	Hetton-le-Hole, D. Willington, North	Shotton Shotton	1848	Miner Miner

Table 5.51 cont. Easington Parish Marriages

	Birthplace	Residence before Marriage	Date	1851 Residence & Occupation
28)	Lee Row, Durham Usworth, Durham	S. Hetton S. Hetton	1847	S. Hetton Miner
29)	Houghton, Durham Wallsend, North	Haswell Haswell	1845	S. Hetton Miner
30)	Downs, Durham Felling, Durham	S. Hetton S. Hetton	1848	S. Hetton Miner
31)	Fawdon, North Jarrow, Durham	Haswell Haswell	1849	Salter's Lane Miner
32)	Heworth, Dur Hetton, Dur	Haswell Haswell	1849	Salter's Lane Miner
33)	N. Shields, North Scremerston, Dur	Easington Easington	1849	Salter's Lane Miner
34)	Sunderland, Dur Percy Main, North	Haswell Haswell	1849	Salter's Lane Enginewright
35)	Chester-le-St, Dur Chester-le-St.	Shotton Coll Shotton Coll	1844	Salter's Lane Miner
36)	Shilbottle, North Jarrow, Durham	S. Hetton S. Hetton	1851	S. Hetton Miner

d) Marriages in Castle Eden Parish

1)	Broughton, Yorks Monk Heseldon, Dur	Castle Eden P. Castle Eden P.	1822	Castle Eden Farmer
2)	Bp. Middleham, Dur Castle Eden, Dur	Bp. Middleham P. Castle Eden P.	1826	Castle Eden Agric Labourer
3)	Pensher, Durham W. Auckland, Dur	Monk Heseldon Castle Eden	1827	Castle Eden
4)	Castle Eden, Dur Newcastle, North	Castle Eden Castle Eden	1830	Castle Eden Farmer
5)	Trimdon, Dur Castle Eden, Dur	Dalton-le-D. P. Castle Eden	1831	Castle Eden

Table 5.51 cont. Castle Eden Marriages

	Birthplace	Residence before Marriage	Date	1851 Residence & Occupation
6)	Castle Eden, Dur Castle Eden, Dur	Castle Eden Castle Eden	1835	Castle Eden Labourer
7)	Danby, Yorks Long Benton, North	Castle Eden Wingate	1842	Castle Eden Agric Labourer
8)	Easington, Dur Shotley Field, Dur	Cotsford Gr. Easington Castle Eden	1846	Castle Eden Blacksmith
9)	Stokesly, Yorks Newborough, North	Castle Eden Castle Eden	1850	Castle Eden Schoolmaster
10)	Horncliffe, North Kelloe, Durham	Castle Eden Castle Eden	1849	Castle Eden Agric Labourer
11)	Shotton, Dur Easington, Dur	Castle Eden Castle Eden	1850	Castle Eden Blacksmith
12)	Pittington, Dur Newton Mulgrave, Yorks	Monk Heseldon Castle Eden	1851	Plate-layer Castle Eden

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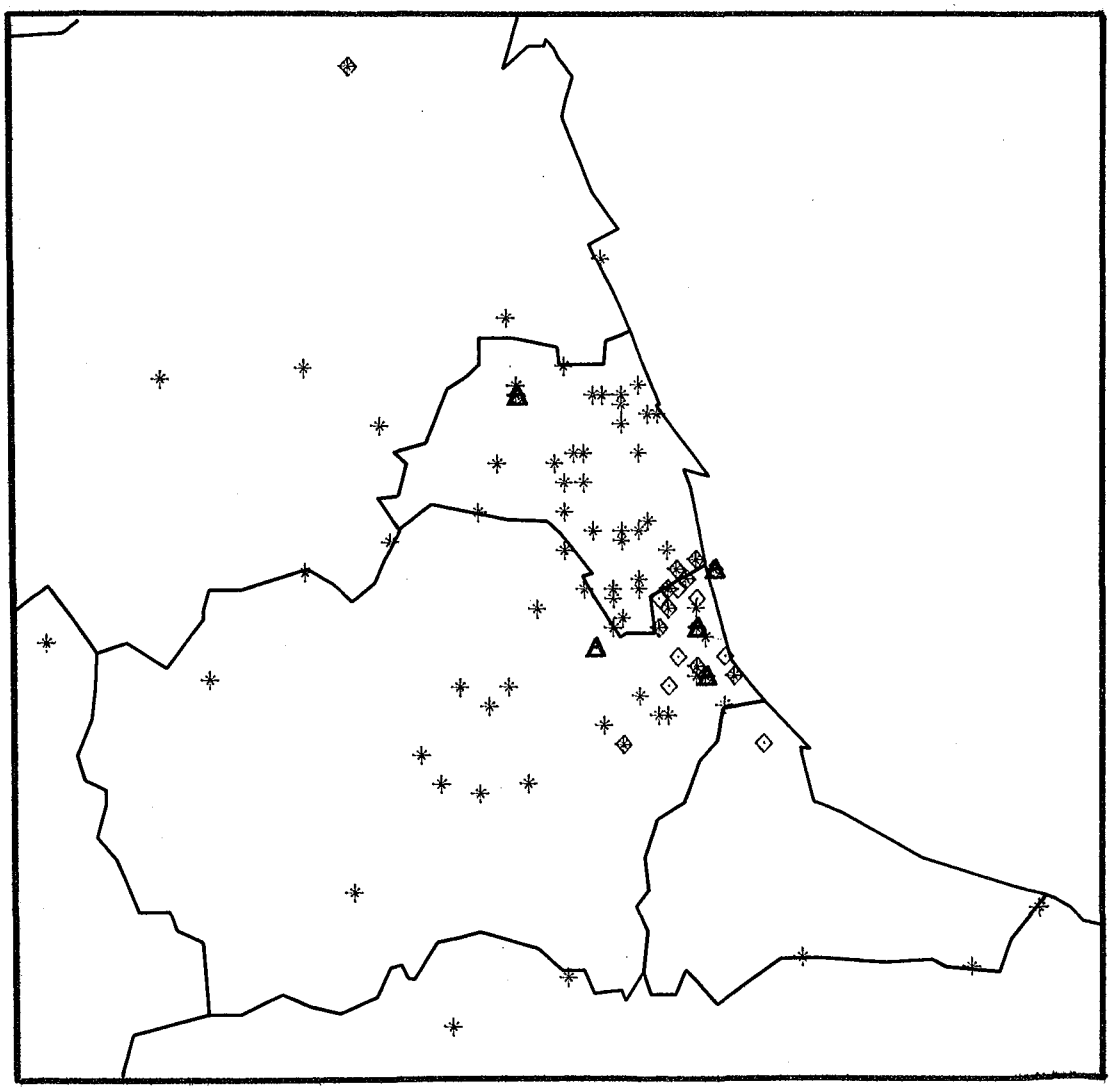
MAP 5.19: NORTH-EASTERN DISTRIBUTION OF BIRTHPLACES AND RESIDENCES: LINKED SAMPLE

Blue stars = birthplaces of individuals
Red diamonds = residence before marriage (Register data) of individuals



CHAPTER 6: DISCUSSION AND CONCLUSION

A discussion of the historical evidence on movement in the nineteenth century has highlighted the enormous extent and volume of migration into the study area, as into other new industrial areas, and the interpretation of such mobility presents a daunting task to the population geneticist who has limited data available. In this project a two-pronged approach has been used in an attempt to unravel some of the main patterns of movement which could be used to predict changes in the genetical structure of the area.

The two different data sources have, at first sight, produced conflicting results for some variables but upon closer examination these differences can be resolved. Before doing this it would be best to summarise the major points arising from each of the data sources.

A common defect of the Anglican Parish register material is its possible unrepresentativeness; but we have seen that even after 1837, the only significant group to be ommitted from these Marriage registers was the Irish-Catholic community in Seaham Harbour which may have exhibited a different pattern of movement. This was an unfortunate loss, but at least the mining group, which formed the majority of the population, was well represented.

The great advantage of using this material was that it enabled an examination to be made of changes in patterns of marital movement over time, and particularly the comparison between the late agricultural and mining phases. One difficulty in attempting this was the change in registration detail required on place of settlement of the marital partners: the ambiguous phrase 'of the parish of N.' given before 1837 was altered to the more precise 'residence before marriage'. The latter term was less ambiguous but if the earlier statements did refer to birthplace (although it is not at all clear that this was so) this might itself be the major underlying cause of an apparent increase in endogamy in the late period. However, in one of the parishes - Castle Eden - there was a very real trend for increasing exogamy after 1837 which suggests that the very high rates of endogamy seen in the other three parishes were not just an artefact of the data. In fact, the increase in endogamy of a unit, whether parish or township, was, with a few exceptions positively correlated with size. The inhabitants of the small villages with their rural population were much more likely to find partners outside the village than the inhabitants of the larger, more compact collieries and the town of Seaham Harbour.

When exogamy did occur, and when marriages with outside world partners were ignored, the likelihood of finding a mate was largely dependent on distance. Disruptions to both these trends - increasing endogamy with size and diminishing exchange with

distance - were caused by positive assortative mating for occupation, particularly for the three dominant occupational groups in the area, and to a lesser extent, social class. As a corollary, miners exhibited remarkably higher rates of spatial exogamy in rural places such as Castle Eden in which the proportions of miners were very small.

In the matrix analyses the partners of exogamous marriages were taken to represent migration into the parish in which the ceremony was held and the higher rates of endogamy in the late period led to an increase in the time taken for the parishes to be related. Greater exogamy in Castle Eden caused it to be related to 'outside world' long before any of the other parishes. Despite strong, positive assortment for occupation, homogenisation between them was obtained much more quickly than for the geographical entities but the miners and agriculturalists were the most slow. Further, mobility between occcupational goups was less conducive to bringing groups together than exchanges through marriages which supports observations on the tendency of the miners sons to follow their fathers into the pit and the economic advantages of handing down land from father to son.

The 1851 census results have revealed the great variety of birthplaces of both the older rural communities and as expected, the new mining and sea-faring communities. The greatest variety

of people was found in Seaham Harbour, its more diverse economy providing the stimulus for movement over very large distances. However, birth-town endogamy, particularly in the mariner group suggest that their might well have existed a number of separate 'breeding units'. The Irish-Catholic community forming one distinct group, the miners and seafarers others. In the Census data, we are dealing with a 'real' phenomenon of migration and can observe differences in the orientation of movement between the collieries, villages and Seaham Harbour. Northumbrian migrants are more common in the collieries than the villages where Yorkshiremen are more frequent. Long-range migration (southern England, Scotland, Ireland) was greatest to Seaham Harbour, while miners and members of the traditional rural occupations were moving over much shorter distances. In the matrix analysis, the range and variety of migration is brought out in the low numbers of generations taken to reach 95% relatedness, particularly when 'outside world' is included. Unfortunately, the different orientation of movement could not be adequately taken into account. In complete contrast to the parish results migration into Castle Eden was lower than into the other parishes and consequently this parish usually took more time than the others to become related to outside world groups.

What can be said about the genetical variation existing in the area before and after this phase of migration? Before the industrial period we have to rely on the parish registers alone

to answer this question. If the data are taken at face value, the matrix analysis has indicated that migration into the area was fairly low but steady (of the order of 15%) and numbers of generations suggest that little heterogeneity in the study area would have existed at the end of this period. Numbers (range was 17 to 24) are very similar to those produced by Otmoor and Pocklington in comparative periods (respectively ranging from 15 to 25 and 10 to 25 generations) when outside world was taken into consideration which implies that similar mobility was occurring in rural places at this time in very different parts of the country. The behaviour of Castle Eden after 1837 is also very close to that of Otmoor. increased exogamy with the outside world causing homogenisation with these populations to occur fairly rapidly; but at the same time a reduction in migration with the other members of the study area would tend to promote heterogeneity within it. This theme is continued when the Census and Parish data are considered together in the mining phase.

Firstly, the matrices of the four parishes only, produced very different results in terms of total number of generations. As 'outside world' migration was not included the effects of heavy industrial migration can be discounted and we see here a much greater movement between birthplace and residence after marriage within this area which causes relatedness between the parishes to be achieved more quickly than that predicted by using 'residence' information alone.

Effectively, the parish data supplies evidence of the network of social contact between parishes or townships but the census data is a much better indicator of the genetical effect of the actual movement of individuals between places. However it must be borne in mind when comparing these two sources that the census is only a glimpse of the population early on in this industrial phase. It would have been very informative to have compared the extent of sedentism in 1851 with that shown by the 1871 or 1881 censuses when the migration rate was lower.

Secondly, the contrasting situations predicted by the two sets of matrices incorporating outside world in the industrial period can, in a sense be taken to represent maximal and minimal limits of time taken to achieve relatedness, and thus genetical uniformity. On the one hand the use of residence as opposed to birthplace is seriously underestimating the amount of contact between distant places and the figures should be much lower; on the other hand the method is inadequate to cope with a sub-divided outside world and the differentiation clearly found is not taken into account in the very low numbers of generations. The major differentiation appears to be between the collieries, Seaham Harbour and the villages and as the registers indicated little intermarriage between these entities, it is contended that at the end of this period genetic differences would be found between these three groups and not a uniform dispersal of genetic traits. Essentially, a patchwork of genetical variation would

exist. For instance, Murton Colliery and Seaham Harbour were spatially close together (4.5km) but little marriage exchange between them and variation in the distribution of birthplaces of their inhabitants would suggest a very different genetical structure in each and differentiation between them.

Between collieries, though, these differences would be minimal particularly in the light of the circularity of movement between them evinced by the birthplaces of their children which encompassed a large part of the coalfield. Certainly, the close-knit inward looking mining communities in which the majority of inhabitants were born, lived and died in the same place, which is documented by modern researchers (Taylor, 1967) developed much later.

This was a time of flux, when social and economic conditions caused frequent movement over small distances, particularly of the coal-miners. The miner's bond and the housing provision all promoted contact between the collieries in Northumberland and Durham and suggest a fair degree of homogeneity between them Only later, when communities stabilised and there was an excess of labour would there perhaps occur the conditions for differentiation.

Would this pattern be applicable to other industrial communities? I suggest that it might well apply to other

coal-mining regions but other industrial workers may have been better integrated in the local population and therefore this variegated pattern might not develop. In this study, the 'industrial' group did not exhibit occupation endogamy or the propensity to marry into other 'industrial' families to the same degree as the coal-miners, in fact many of them married into mining and crafts families. In many respects sociological factors make the miners a special case.

Apart from these genetical interpretations, the social factors underlying these observations are most interesting and deserve some attention. A strong tendency for intermarriage in the rural population is explicable in terms of the economic advantage that is accrued in pooling resources but high intermarriage in the coal-mining population is not as easily comprehensible. Because houses were provided for pitmen they congregated together so there would be a greater chance that a potential spouse would be of a mining family too. But we have seen that there is more to it than this (cf Castle Eden), miners will marry 'out' of their settlement in preference for a spouse of the same occupational group; perhaps the nature of the work, the long hours, shift-work caused this closeness. The mariners too were concentrated in certain areas because of the nature of their employment and they exhibited high levels of birth-place endogamy which is comprehensible in terms of both the larger size of their birthplaces and the long time spent away at sea, offering little

opportunity to finding spouses further afield. Endogamy in the Irish community is due to a variety of causes, not least is the different religion which discouraged intermarriage with other Christian sects, and their status in the community.

A piece of research is never complete in itself, modifications and improvements can always be made and new methods of dealing with problems are often revealed throughout the course of the work. This piece of research is no exception. The migration matrix technique was fairly straightforward to use and had the advantage of incorporating observed migration rates but some weaknesses and defects in the model have come to light. The difficulties arising from ambiguous data, mainly in the parish registers, has already been commented on and it is clear that the Census is a much more accurate source to use. However, it would not be wise to discount parish registers altogether at this particular period. Their detail on intermarriage between occupational groups and social classes has been essential in determining interbreeding groups.

Another problem was the lack of time depth in the Census material. This could be overcome to a certain extent by examining all the available censuses 1851-1881, and comparing rates of migration in each. There would be far too much material in these to deal with fully, so a sampling strategy could be devised and the material amalgamated in one large matrix so that

'average' movement over the whole period is considered.

In order to also utilise the social data in the registers, the linkage technique commenced here could be extended by linking all possible couples in the censuses (1851-1881) with the marriages of the same period. Both an accurate measurement of geographical mobility and occupational mobility would then be possible.

The major problem with the use of these matrices is the inability to sub-divide the outside world, which was particularly acute in this area. The only solution would be to look for out migration from the study area which would unfortunately be an impossible task given present resources.

In conclusion, despite many difficulties, the combination of Anglican parish register and Census has enabled the aims of this project to be fulfilled on the whole: migration has been described and measured, an attmept has been made to determine the presence of 'breeding groups' and the resulting genetical variation in the study area has been predicted.

Appendix A

PROGRAM FOR OBTAINING NUMBER OF GENERATIONS TO ACHIEVE HOMOGENEITY, WRITTEN BY W.R. WILLIAMS

```
      REAL*8 A(50,50),  R(50,50), ATEMP(50,50),
     +       TEMP,P(50,50),HOLD
      INTEGER*4  GEN(9,9),ROUND,TOTAL,EN,SEN,LP,KP,SFR,FR,
                 IP(9,9)
C READ IN SIZE OF MATRIX,NUMBER OF GENERATIONS AND THE
C DATA FILE
      READ (5,*) N, NGENS
      READ (5,*) ((IP(J,K),K=1,N),J=1,N)
C CALCULATE PROPORTIONS FOR EACH ELEMENT
      DO 95 I=1,N
      ISUM=0
      DO 90 J=1,N
      ISUM=ISUM+IP(I,J)
90    CONTINUE
      DO 95 J=1,N
      P(I,J)=FLOAT(IP(I.J))/FLOAT(ISUM)
95    CONTINUE
C INITIALISE ALL MATRICES TO 0.0 WITH A(J,J)=1.0
```

```
      DO 100 K = 1, N
      DO 100 J = 1, N
C
      ATEMP(J,K) = 0.0000
      A(J,K) = 0.0000
      IF(J.EQ.K)A(J,K)=1.000
      R(J,K) = 0.0000
      GEN(J,K)=0
  100 CONTINUE
C
      ITER = 0
      ROUND=0
      TOTAL=(N*(N-1))/2
C
C MULTIPLY MATRICES TOGETHER
120   ITER=ITER+1
      DO 135 J = 1, N
      DO 135 K = 1, N
C
      SUM = 0.0000
C
      DO 130 L = 1, N
      SUM = SUM + (A(J,L) * P(L,K))
      TSUM=A(J,L)*P(L,K)
  130 CONTINUE
C
```

```
C STORE RESULT OF COLUMN*ROW MULTIPLICATION IN A TEMPORARY
C ARREY
      ATEMP(J,K) = SUM
  135 CONTINUE
C
C
C FOR ANY TWO ROWS  FIND THE SMALLEST ELEMENTS OF EACH COLUMN
C PAIR AND ADD THEM TOGETHER. STORE RESULT IN 'R'
      NLESS = N - 1
C
      DO 153 J = 1, NLESS
      JPLUS = J + 1
C
      DO 153 M = JPLUS, N
C
      HOLD=0.0
        DO 150 K = 1, N
        TEMP=ATEMP(M,K)
        IF (ATEMP(J,K) .LT. ATEMP(M,K)) TEMP=ATEMP(J,K)
        HOLD = HOLD + TEMP
150     CONTINUE
C PUT BACK IN ARREY NEW VALUE
      R(J,M)=HOLD
C TEST VALUE FOR LIMIT OF .95
      IF(R(J,M).LT.0.95)GO TO 153
      IF(GEN(J,M).NE.0)GO TO 153
```

```
C
C HAVE A VALUE GREATER THAN 0.95 FOR THE FIRST TIME
      GEN(J.M)=ITER
      ROUND=ROUND+1
153   CONTINUE
C
C
C SEE IF FIRST GENERATION. IF SO PRINT RELATIONSHIP MATRIX
      IF(ITER.NE.1)GO TO 154
C CALCULATE INDEX OF THE COLUMNS TO PLOT ON THIS INDEX
      INDEX=0
      WRITE(6,630)
170   INDEX=INDEX+1
      FR=(15*(INDEX-1))+1
      EN=FR+14
      IF(EN.GT.N)EN=N
C WRITE COLUMN HEADER
      WRITE(6,600)(I,I=FR,EN)
      SFR=FR+1
      DO 175 LP=SFR,N
C SET INDEX TO GIVE TRIANGULAT MATRIN BY IMPLIED DO LOOP
      SEN=LP-1
      IF(SEN.GT.EN)SEN=EN
C WRITE LINE OF MATRIX
       WRITE(6,640)LP,(R(KP,LP),KP=FR,SEN)
175   CONTINUE
```

```
C IF ALL MATRIX NOT WRITTEN OUT CONTINUE WITH ANOTHER CYCLE
      IF(EN.NE.N)GO TO 170
C TRANSFER TEMPORARY ARREY BACK TO MAIN ARREY
154   DO 140 K = 1, N
      DO 140 J = 1, N
C
      A(J,K) = ATEMP(J,K)
  140 CONTINUE
C     WRITE(6,665)((R(I,J),J=1,N),I=1,N)
      IF(ROUND.EQ.TOTAL)GO TO 155
      IF(ITER.NE.NGENS)GO TO 120
C PASS THROUGH MATRIX AND REPLACE EVERY LOCATION WHICH HAS
C NOT YET ACHIEVED HOMOGENEITY WITH THE MAXIMUM NUMBER OF
C GENERATIONS PASSED THROUGH, IE. 'NGENS'
155   DO 157 I=1,NLESS
      JPLUS=I+1
      DO 157 J=JPLUS,N
      IF(GEN(I,J).EQ.0)GEN(I,J)=NGENS
157   CONTINUE
C WRITE MATRIX OUT TO FILE UNIT 7
      DO 159 I=2,N
      JPLUS=I-1
      WRITE(7,620)(GEN(J,I),J=1,JPLUS)
159   CONTINUE
C CALCULATE INDEX OF THE COLUMNS TO PLOT ON THIS ROUND
      WRITE(6,650)
```

```
      ROUND=0
160   ROUND=ROUND+1
      FR=(15*(ROUND-1))+1
      EN=FR+14
      IF(EN.GT.N)EN=N
C WRITE COLUMN HEADER
      WRITE(6,600)(I,I=FR,EN)
      SFR=FR+1
      DO 185 LP=SFR,N
C SET INDEX TO GIVE TRIANGULAT MATRIN BY IMPLIED DO LOOP
      SEN=LP-1
      IF(SEN.GT.EN)SEN=EN
C WRITE LINE OF MATRIX
      WRITE(6,610)LP,(GEN(KP,LP),KP=FR,SEN)
185   CONTINUE
C IF ALL MATRIX NOT WRITTEN OUT CONTINUE WITH ANOTHER CYCLE
      IF(EN.NE.N)GO TO 160
      STOP
 165  FORMAT (I3)
600   FORMAT(/////10X,15(I5))
610   FORMAT(3X,I4,3X,15(I5))
620   FORMAT(50I5)
630   FORMAT('1 RELATIONSHIP MATRIX AFTER ONE GENERATION')
640   FORMAT(3X,I4,3X.15(1X,F4.3))
650   FORMAT(///'GENERATION MATRIX')
      END
```

Appendix B

PROGRAM TO PLOT POINT DISTIBUTION MAPS, WRITTEN BY R.W. WILLIAMS

```
C     Program to plot map of G|B.
C
      REAL  J(1000),X(2),Y(2),XCORD,YCORD,LASTX,LASTY,
     +       XFIX(5),YFIX(5)
      INTEGER*2 TYPE,CODE,SOCL,OCCUP,MORE,
     +         SOCLT,OCCUPT,PERSON,PEN,INX(2),INY(2)
      INTEGER*4 ICHAR,RESID,RESIDT,COUNT,COUNT2
      DATA XFIX/430.0,422.0,443.0,442.0,441.0/,
     +     YFIX/541.0,567.0,549.0,538.0,543.0/
C
      CALL FTNCMD('ASSIGN 7=COUNTY;')
      CALL FTNCMD('ASSIGN 10=-TEMP#1;')
      CALL FTNCMD('ASSIGN 11=-TEMP#2;')
      CALL PAPER(1)
      CALL PSPACE(0.0.0.7,0.0,1.0)
      CALL MAP(0.0,10.0,0.0,10.0)
      CALL BORDER
      CALL CTRSET(4)
      CALL PSPACE(0.0,1.0,0.0,1.0)
```

```
      CALL CSPACE(0.0,1.0,0.0,1.0)
      CALL MAP(0.0,9999.0,0.0.9999.0)
      KK=0
C     IF(KK.EQ.0)GO TO 120
100   READ(7,500,END=120) IL,IR,I,(J(K),K=1,12)
      IF(I.GT.12)READ(7,510) (J(K),K=13,I)
C
      CALL POSITN(J(1),J(2))
      M=1
      N=2
C
110   M=M+2
      N=N+2
      IF(M.GT.I)GO TO 100
C
      CALL JOIN(J(M),J(N))
      GO TO 110
C
120   CALL CTRSIZ(30.0)
      DO 125 I=1,5
      XCORD=XFIX(I)*10
      YCORD=YFIX(I)*10
      CALL PLOTNC(XCORD,YCORD,50)
125   CONTINUE
      CALL CTRSIZ(30.0)
C     IF(KK.EQ.0)GO TO 999
```

```
130   WRITE(6,640)
      READ(5,*)ICHAR
      WRITE(6,650)
      READ(5,*)PEN
      WRITE(6,645)
      READ(5,*)RESIDT
      WRITE(6,610)
      READ(5,*)SOCLT
      WRITE(6,600)
      READ(5,*)OCCUPT
      WRITE(6,615)
      READ(5,*)PERSON
      CALL EMPTYF(10)
      CALL EMPTYF(11)
      REWIND 8
      IF(PEN.EQ.1)CALL REDPEN
      IF(PEN.EQ.2)CALL BLUPEN
      IF(PEN.EQ.3)CALL GRNPEN
      COUNT=0
      COUNT2=0
135   READ(8,520,END=140)RESID,SOCL,OCCUP,INX(1),INY(1),
      INX(2),INY(2)
C     WRITE(6,666)SOCLT,SOCL,OCCUPT,OCCUP,X(1),Y(1),X(2),Y(2)
666   FORMAT(1X,2I3,5X,2I3,5X,2F6.1,10X,2F6.1)
      IF((INX(PERSON).EQ.0).OR.(INY(PERSON).EQ.0))GO TO 135
      IF(SOCLT.EQ.99)GO TO 136
```

```
      IF(SOCLT.NE.SOCL)GO TO 135
136   IF(OCCUPT.EQ.99)GO TO 137
      IF(OCCUP.NE.OCCUPT)GO TO 135
137   IF(RESIDT.EQ.999999)GO TO 145
      IF(RESID.NE.RESIDT)GO TO 135
145   WRITE(10,670)INX(1),INY(1),INX(2),INY(2)
      COUNT=COUNT+1
      GO TO 135
140   REWIND 10
      IF(PERSON.EQ.1)CALL
      SORT('S=CH,A,1,6 I=* O=* E ',10,11,&900)
      IF(PERSON.EQ.2)CALL
      SORT('S=CH,A,7,6 I=* O=* E ',10,11,&900)
      REWIND 11
      READ(11,530)X(1),Y(1),X(2),Y(2)
143   LASTX=X(PERSON)
      LASTY=Y(PERSON)
      XCORD=X(PERSON)*10
      YCORD=Y(PERSON)*10
      CALL PLOTNC(XCORD.YCORD,ICHAR)
      COUNT2=COUNT2+1
149   READ(11,530,END=150)X(1),Y(1),X(2),Y(2)
      IF((LASTX.EQ.X(PERSON)).AND.(LASTY.EQ.Y(PERSON)))GO TO
      149
      GO TO 143
150   WRITE(6,660)COUNT
```

```
      WRITE(6,663)COUNT2
      WRITE(6,620)
      READ(5,*)MORE
      IF(MORE.EQ.1)GO TO 120
999   CALL GREND
      STOP
C
900   WRITE(6,901)
      GO TO 999
C
500   FORMAT(1X,I6,2I3,12F5.0)
510   FORMAT(13X,12F5.0)
520   FORMAT(3X,I6,I1,I1,22X,4I3)
530   FORMAT(4F3.0)
600   FORMAT(//' OCCUPATION CODE 0=NO 1,2 ETC  (99=NOT USE) ')
610   FORMAT(//' SOCIAL CLASS CODE 0=NO 1,2 ET (99=NOT USE) ')
615   FORMAT(//' PERSON CODE 1,2')
620   FORMAT(//' CONTINUE WITH ANOTHER SELECTION 1=YES 2=NO')
630   FORMAT(I2,1X,I2,1X,F10.3,1X,F10.3)
640   FORMAT(//' CHARACTER INDEX TO PLOT ?')
645   FORMAT(//' RESIDENCE CODE (NOT USED=999999) ?')
650   FORMAT(//' PEN COLOUR 1=RED  2=BLUE  3=GREEN')
660   FORMAT(//' NUMBER OF POINTS SELECTED FOR THE GIVEN
      OPTIONS WERE ',I4)
663   FORMAT(//' ACTUAL NUMBER OF UNIQUE POINTS PLOTTED WERE
      ',I5)
```

```
670   FORMAT(4I3)
901   FORMAT(' ERROR IN SORT')
C
      END
```

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